International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(6): 1522-1527

Received: 14-09-2017
Accepted: 16-10-2017

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Assessment of groundnut (*Arachis hypogea* L) genotypes for plant geometry during *kharif* Season

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Abstract
The experiment was conducted during *Kharif* season in the Block B-12 at college farm, Department of Agronomy Vasantrao Naik Marathawada Agricultura University, Parbhani, to study the "Assessment of Groundnut (Arachis hypogeal L) Genotypes for plant Geometry during *Kharif* season. The experiment was laid out in factorial RBD with the replications. Total nine treatment combinations consisted of three genotypes (TAG-24, TAG-26, TAG-19) and three plant geometry (30cmx10cm, 30cm x 15cm and 22.5cm x 10cm). All three varieties are released from Trombay. So the name is given Trombay Groundnut (TG) with the help of radiation at Bhabha Atomic Research Centre. The genotypes were tolerant to bud necrosis and jassids. Among more promising to produce higher biomass and pod yield compare to TAG-24 and TG-26 for the cultivation during *kharif* season exposed to various biotic and abiotic stress. The spacing of 30cm x 10 cm was found optimum to produce higher pod yield compared to wider spacing 30cmx 15cmas well as closer spacing 22.5cm x10cm. The oil content was higher in TG-26 i.e. (45.61) over TAG-24 and TG-19. Similarly TAG-24 (44.50) was significantly superior over TG-19(43.39) in producing oil.

Keywords: Geometry, yield, quality, groundnut, 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.
In Marathwada region groundnut is cultivated in *kharif* and summer season. The oil content of kernels varies from 44-50% depending on the varieties and agro-climatic conditions as it is grown in a diverse agro climatic environment characterized by variation in rainfall; temperature, radiation photoperiod and soils of varying moisture retention capacity. The low production of groundnut is due to the fact that most of the area in India is under rain fed cultivation and exposed to the erratic distribution of rainfall during crop growth. Unavailability of suitable variety for rain fed condition is also another reason coupled with infestation of disease like rust, tikka and bud necrosis.
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 (Kumar and Venatachari, 1971). The newly developed varieties through radiation at Bhaba Atomic Research Center (Trombay) in relation with SAU, performed well and produce targeted yield during rabi and summer season. These varieties are being popular on cultivars field due to high yield potential, moderate tolerance to pest and diseases and having adjusting nature to climatic variation. These genotypes are Spanish bunch having variation in phonology. In rabi and summer season of Marathwada region these genotypes are performing well and produced potential yield. However, these genotypes potential during kharif season is necessary to evaluate.

Materials and Methods
The experiment was conducted during *kharif* season of 2003 in the block B-12 at college farm, department of Agronomy, Marathwada Agricultural University, Parbhani.

Soil samples were taken before sowing from 30cm depth at four random places in the field of experimental area to study the physical chemical properties of soil. The data of soil analysis revealed that the soil was clayey in texture, low in total nitrogen and available phosphorus and fairly rich in available potassium and slightly alkaline (pH 8.3) in reaction. Climate and weather Parbhani is situated at 409 m altitude 190 16'N latitude and 760 47'east longitude in Marathwada division of Maharashtra state and has a semi- arid climate.

Parbhani is grouped under assured monsoon rainfall zone with an average annual precipitation of 905 mm. The total rainfall during the period of investigation in *kharif* season was 648 mm (July to November) and no long dry spell occurred except at 43rd MW. The mean maximum temperature ranged between 29^0C to 33.9^0C. While, mean minimum temperature fluctuated from $16.1\ ^0$ C to 23^0 C.

The experiment was laid out in factorial RBD with three replications. Total nine treatment combinations consisted of three genotypes (TAG-24, TG-26, TG-19) and three plant geometry (30 cm X 10 cm, 30cm X 15cm and 22.5cm X 10cm). All three varieties are released from Trombay so the name is given Trombay groundnut (TG) with the help of radiation at Bhabha Atomic Research Centre. The genotypes were tolerant to bud necrosis and jassids. The layout consisted of 27 experimental plots in three replications. Each replication was divided in to 9 experimental units. Each experiment unit was 4.5 m X 4.5m in size. The treatments were randomly allotted to different plots. The field was ploughed 30cm deep in summer and fine tilth was obtained by subsequent harrowing. Layout marking and fertilizer application. The fertilizer dose of 25kg nitrogen/ha was given in the form of urea and 50kg/ha of phosphorous through single super phosphate. The fertilizer was applied along the marked lines 5cm below the soil surface before sowing.

Seed and Sowing

The pods of groundnut genotypes under study was shelled at the time of sowing. The kernels were treated with Bavistin @ 2.5 g/kg of seed. Sowing was done by dibbling 30cm X10cm, 30cm X 15cm and 22.5cm X 10cm by keeping seed rate 100 kg per ha. Sowing was done when adequate rainfall occurred. Gap filling was undertaken 10 DAS to maintain optimum plant population or plant stand.

Irrigation

Only two irrigations were given to the crop when dry spell occurred.

Harvesting and Drying Of Pods

After maturity, the crop was harvested by uprooting the plants. The fresh pods from each net plots were weighed and kept in gunny bags and labelled properly and thereafter they were sundried separately for about a week until nearly constant weight were obtained. Plot wise pod yield and haulm yield weighed separately.

Sampling Technique

To monitor periodical growth and developmental characters at different stages, five plants were selected randomly from each plot. The same plants were harvested separately for recording individual plant yield at maturity. For dry matter studies one plant at each observation was taken from the gross plot area.

Results

The important findings in the form of summarized data on growth, yield and their attributes analyzed and the critically interpreted results.

Table No 1: Biometric Parameters of groundnut as influenced by various treatments.

Treatments	Height of plant (cm)	Number of branches	Leaf area (cm^2)	Number of nodules	Total dry matter/ plant
Genotypes					
V1:TAG-24	19.33	5.31	13.52	75.67	33.80
V2TG-26	18.90	5.16	14.07	74.23	31.90
V3TG-19	20.85	6.79	15.19	82.57	36.69
SE+_	0.32	0.58	0.23	0.59	0.71
CD at 5%	0.97	NS	0.68	1.76	2.12
Plant geometry (cm)					
S1:30x10	19.62	5.72	15.19	77.36	34.50
S2:30x15	18.95	6.72	15.37	78.46	36.47
S3:22.5x10	20.67	5.32	14.68	76.95	31.41
SE+_	0.32	0.58	0.23	0.59	0.71
CD at 5%	0.97	NS	0.68	NS	2.12
Interaction (V x S)					
SE+_	0.57	1.03	0.40	1.02	1.26
CD at 5%	NS	NS	NS	NS	NS

Plant Height

The plant height was influenced significantly by genotypes at all stages of crop growth. Genotype TG-19 recorded significantly more plant height over other two genotypes (TAG-26) at all crop growth stages .However, the latter genotypes were found at par with each other. The effect of different plant geometry significantly influenced the plant height at all crop growth stages. The spacing 22.5 cm showed maximum height and was significantly superior over 30 cm x 15 cm Where 30 cm x 10 cm spacing being at par with each other .The interaction effect between genotypes and plant geometry for mean plant height was non-significant at all crop growth stages.

Number of Branches

The effect of different genotypes on number of branches per plant was significant. At these stages TG-19 genotypes recorded significantly more number of branches per plant over TAG-24 and TG -26.However, TAG-24 and TG-26 was at par with each other. Different spacing tried showed their significant influence in increasing the number of branches per plant. The number of branches per plant was significantly superior at 30 cm x a15 cm over 22.5 cm x 10 cm however, 30 cm x 15 cm spacing at par with each other. The interaction effect between genotypes and spacing was found to be non-significant at all crop growth stages.

Leaf Area (dm2) Per Plant:- The effect of genotypes on mean leaf area per plant was significantly at all the stages of crop growth. Genotypes TG-19 recorded significantly highest leaf area than TAG-24 and TG-26 at all the crop growth stage. The genotype TAG-24 and TG-26 were found to be at par with each other. Different spacing 30 cm x 15 cm produced significantly more mean leaf area per plant over spacing of 22.5 cm x 10 cm, but at par with 30 cm x 10 cm spacing. The interaction of effect of genotype and plant spacing did not reach to the level of significance at all the stages of crop growth.

Nodules per plant:- The different genotypes have significantly influenced the number of nodules per plant at all the crop growth stages .The genotype TG-19 produced significantly more number of nodules per plant over TAG-24 and TG-26.The genotype TAG-24 and TG-26 was at par with each other at all the crop growth stages. The effect of spacing tried in investigation did not influenced the mean number of nodules per plant at all crop growth stages. The interaction effect of genotype and spacing did not influenced the mean number of nodules per plant during the crop growth period.

Total dry matter accumulation (g/plant):- The difference in total dry matter accumulation per plant among three genotypes under study were significantly at all the growth stages. The genotypes TG-19 produced maximum total dry matter per plant which was significantly higher than TAG-24 and TG-26 However, TAG-24 and TG-26 were at par with each other up to harvest. The effect of different spacing on total dry matter accumulation was significant at all the crop stages The spacing 30 cm x 15 cm produced significantly higher dry matter over 22.5 cm x 10 cm and at par with the 30 cm x 10 cm at all crop growth stages . The interaction effect of genotype and spacing found to be non-significant at all crop growth stages.

Table No 2: Number of pegs and pod per plant, shelling percentage and hundred kernel weight (g) as influenced by genotypes and plant geometry at harvest.

Varieties	No of pegs /plant	Pod weight /plant (g)	No of /plant	Shelling (%)	100 kernel weight (g)
		Genotypes			
V1 : TAG-24	3.96	9.02	18.14	18.14	28.03
V2 : TG-26	3.25	8.07	16.96	16.96	27.09
V3 : TG-19	5.69	11.04	19.89	19.89	32.33
SE+/-	0.29	0.51	0.45	0.45	0.40
CD at 5 %	0.88	1.53	1.35	1.35	1.20
		Spacing (cm)			
S1 : 30x10	4.42	9.75	18.39	18.39	29.59
S2 : 30x15	5.05	11.13	19.72	19.72	30.32
S3 : 22.5x10	3.42	7.25	16.88	16.88	27.53
SE+_	0.29	0.51	0.45	0.45	0.40
CD at 5 %	0.88	1.53	1.35	1.35	1.20
		Interaction (V x S)			
SE+_	0.51	0.90	0.80	0.80	0.71
CD at 5 %	NS	NS	NS	NS	NS

Number of pegs per plant:-Genotypes TG-19 produced significantly more number of pegs than TAG-26. However, genotypes, TAG-24 and TG-26 were at par with each other in respect of pegs per plant. The mean number of pegs per plant was significantly more at 30 cm x 15 cm spacing than 22.5 cm x 10 cm spacing but at par with 30 cm x 10 cm. The interaction effects were not evident.

Number of pods per plant:-There was significant difference among the genotypes in bearing total pods per plant. The genotype TG-19 produced significantly more number of total pods than TAG-24 and TG-26 whereas , TAG-24 and TG-26 both genotypes were at par with each other .The plant spacing 30 cm x 15 cm were at par and produced significantly higher number of pods per plant than 22.5 cm x 10 cm spacing .The interaction effect were not observed .

Weight of pods per plant:-Among the genotypes TG- 19 gave highest dry pod weight per plant which was significantly more than the genotype TAG-24 and TG-26. However, TAG-24 and TG-26 at par with each other .The plant spacing 30 cm x 15 cm produced significantly higher dry pod weight per plant than spacing 22.5 cm x 10 cm and at par with the 30 cm x 10 cm spacing. The interaction effect between genotypes and plant geometry did not reach to the level of significance.

Shelling Percentage:- The genotype TG-19 gave significantly higher shelling percentage (72.06%) than TAG-24 and TG-26 whereas, TAG-24 (68.24) and TG-26 (67.63) are at par with each other. The wider spacing 30 cm x 15 cm gave significantly higher shelling percentage over the narrow spacing 22.5 cm x 10 cm and at par with 30 cm x 10 cm spacing. The interaction effect between genotypes and spacing was found to be non-significant

100 kernel weights:- The genotype TG-19 gave significant highest 100 kernal weight over TAG-24 and TG-26 .However, TAG-24 and TG-26 both genotypes were at par with each .The mean hundred kernel was influenced significantly by spacing .The maximum kernel weight was observed at 30 cm x 15 cm which was significantly more than 22.5 cm x 10 cm spacing at par with the 30 cm x 10 cm spacing .Interaction effect for 100 kernel weight was found to be non-significant.

Dry pod yield:- The dry pod yield was influenced significantly by genotypes. The genotypes TG-19 produced significantly highest dry pod yield (22.36 q/ha) over TAG-24 and TG-26 respectively. However, TAG-24 (18.57 q/ha) and TG-26 (17.29 q / ha were at par with each other .The plant spacing 30cm x 10 cm produced significantly higher dry pod yield (21.20 q/ha) over 30 cm x 15 cm spacing (16.16 q / ha) and at par with the 22.5 cm x 10 cm spacing (20.86 q /ha) which indicate that 30 cm x 10 cm spacing was optimum from the point of view of yield. The interaction effect of genotype and plant geometry under study on dry pod yield was non-evident.

Dry Haulm yield:- The data on haulm yield revealed that the haulm yield was influenced significantly by genotypes. The genotypes TG-19 produced (31.85 q/ha) significantly higher dry haulm yield over TAG-24 (27.44q/ha) and TG-26 (25.19q/ha).However, TAG-24 and TG-26 at par with each other with respect of haulm yield. The effect of various spacing on haulm yield was found to be significant. The spacing 22.5 cm x 10 cm gave significantly higher haulm yield (30.82 q/ha) over 30 cm x15 cm and 30 cm x 15 cm. However, 30 cm x 10 cm spacing (27.42 q /ha) and 30 cm x 15 cm spacing (26.26 q / ha) were at par with each other .The effect of interaction between genotypes and plant geometry were not observed.

Table No.3 –Dry pod yield, haulm yield and biological yield (q/ha) and harvest index (%) as influenced by genotypes and plant geometry at harvest.

Treatments	Pod yield (q/ha)	Haulm yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
Genotypes				
V1 : TAG-24	18.57	27.46	46.03	40.34
V2 : TG-26	17.29	25.19	42.48	40.70
V3 : TG-19	22.36	31.85	54.21	41.24
SE+_	0.78	0.82	1.51	1.56
CD at 5 %	2.34	2.47	4.54	NS
Plant Geometry (cm)				
S1 : 30x10	21.20	27.42	48.62	43.60
S2 : 30x15	16.16	26.26	42.42	38.09
S3 : 22.5x10	20.86	30.82	51.68	40.36
SE+_	0.78	0.82	1.51	1.56
CD at 5 %	2.34	2.47	4.54	NS
Interaction (VxS)				
SE+_	1.39	1.45	2.70	2.75
CD at 5 %	NS	NS	NS	NS

Biological yield (q/ha):- The biological yield was significantly influenced by genotypes. The genotype TG-19 produced significantly higher biological yield (54.21) comp aired with TAG-24 and TG-26.The spacing 22.5 cm x 10 cm produced higher biological yield (51.68q/ha) over 30 cm x 10 cm (48.62q/ha) whereas 30 cm x 10 cm and 30 cm x 15 cm were at par with each other. The interaction effect between genotypes and plant geometry found to be non-significant.

Harvest index:- The data indicated that harvest index was not significantly influenced by genotypes, plant geometry and their interaction effect.

Discussion

Groundnut genotypes:- The genotypes selected for the present investigation were TAG-24, TG-26, TG-19. All three groundnuts under study belongs to Spanish bunch group with erect and compact growth habit. The genotype TG-19 produced more plant height as compared to TAG-24 and TAG-26, which might due to genetic expression of TG-19. Similar differences in different groundnut varieties as regards plant height were reported by Bhan (1971) [4], Deokar (1984) [8], Sable R.N. (2002) at different locations, however TAG-24 and TG-26 marginally differed among the plant height. The number of leaves and leaf area per plant in the genotypes TG-19 recorded more than TAG-24 and TG-26 from 30 DAS up to harvest which may be attributed to differential maturity period and genetical potential. The number of nodules per plant was varied among the genotypes. Higher nodules was recorded by genotypes TG-19 which might be because of maximum growth and development of plants and their roots as compared to TAG-24 and TG-26. Whereas TAG-24 and TG-26 respect with nodules per plant were or less similar with each other. Such differential number of nodules in different groundnut genotypes was also observed by Sundaran *et al*. (1976), Antony *et al.* (2000) [2].

The mean total dry matter per plant was influenced due to groundnut genotype. Genotype TG-19 produced more dry matter as comp aired to TAG-24 and TG-26 at all the stages and at harvest due to higher biomass potential. Such differential dry matter production in different groundnut genotypes was observed by Krishnamurthy *et al.* (1971). However, the dry matter was marginally differed among TAG-24 and TG -26.

The yield attributes viz. Number of pods; pod weight per plant shelling percentage was higher in TG-19. It may be due to higher number of pegs produced in TAG-19 which bears the more number of pods per plant. The TG-19more branches, more height, number of leaves which in turn reflected in increased total dry matter. Thus genotype TG-19 has more potential to produced more photosynthetic by harvesting more solar radiation .The LAI was maximum in TG-19. These are responsible to produced more photosynthetic, which was in turn translocated towards economic parts of TG-19. With regards to pod yield, haulm yield which was maximum genotype TG-19. The increased in the yield TG-19was 16.95 % higher than TAG-24 and 22.68 % than TG-26. The increased in the yield of TG-19 was mainly attributed more number of pods, pod weight compared to TAG-24 and TG-26. Thangavelu *et al.* (1982), Hatwar and Mahajan (1992) Lodh (1994 also observed improvement in yield attributes due to genotype having ability to produced the more number of pods, shelling percentage and dry yield. Similarly Bhosale and Andhale (1981) [5], Jagtap and Deokar (1983) [10], Attarde *et al* (2001) also observed differences in yield attributing character under different genotypes of groundnut.

Differences in shelling percentage was evident by genotypes. The genotype TG-19 produced significantly higher shelling percentage (72.06%). Such varietal difference in shelling percentage were also reported by Tripathi *et al.* (1972). However, TAG-24 and TG-26 in respect of shelling percentage marginally differed with each other. Groundnut genotype TG-19 produced maximum haulm yield (31.87a/ha, which was higher by 13.91 % and 20.97 % than TAG-24 and Tg-26, respectively. The genotype TG-19 also produced higher biological yield.(54.24q/ha).which was higher by 18.14%and 21.74% than TAG-24and TG-26,respectively.The higher haulm and biological yield of TG-19compaired to TAG-24and TG-26 may be attributed to accumulation of more dry matter and higher biomass production. Such types of findings in case of groundnut genotypes were reported by Attarde *et al.* (2001).

Plant geometry - In general, plant height of groundnut was influenced due to spacing from early stage up to harvest. The increase in height was slow initially due to seeding stage. The height was increased very rapid ally during active vegetative phase from 31to 90 DAS. Thereafter, it was slightly increased up to harvest. The closer spacing 22.5 cm x 10 cm recorded more height as compared to wider row spacing of 30 cm x 15 cm. In gengral, height was increased as the plant density was increased indicating tendency of plants to grow tall under inadequate space. Similar types of results was reported by Saini *et al.* (1980) [13]. It was evident from data that increased in numbers of leaves and leaf area per plant was continued up to 110 DAS because of active vegetative phase and decreased thereafter due to leaf senescence. During reproductive phase number of leaves was improved with lower plant density i.e. wider spacing 30 cm x 15 cm as compared to 22.5 cm x 10 cm. similar type of results was also observed by Karle (1989) [11]. The availability of more space in wider spacing for the maximum extraction of moisture and nutrients from soil and interception of more sunlight contributed to increased number of leaves and leaf area per plant. The number of nodules per plant was also affected due to spacings. Higher mean number of nodules per plant was recorded by wider spacing 30 cm x 15 cm as compared to closer spacing 22.5cm x 10 cm. Which might be because of maximum growth and development of plants and their roots elongation due to wider spacing? Such differential number of nodules in groundnut due to different spacing was also observed by Bhan and Mishra (1971) [4]. While difference in producing the number of nodule at 30 cm x 10 cm spacing was marginal.
The wider spacing of 30 cm x 15 cm proved superior in increasing number of pods per plant and pod weight per plant than closer spacing of 22.5 cm x 10 cm .similar types of results reported by the Mozingo *et al.* (1989) that the number of pods per plant decreased with closer spacing. The higher yield of groundnut under spacing 30 cm x 10 cm was associated due to higher and greater formation of total pods at harvest .Higher yield obtained at 30 cm x 10 cm because for plant growth and yield plant occupied optimum and uniform space at 30 cm x10 cm than 30 cm x 15 cm spacing . These results are in line with Ragjavaith *et al.* (1995) who reported that 30 cm x 10 cm spacing resulted in significant pod yield over 30 cm x 15 cm Shelling percentage was also influenced by spacing. The wider spacing 30 cm x 15 cm produced the higher shelling percentage than closer spacing 22.5 cm x 15 cm but marginal difference with 30 cm x 10 cm spacing. Similar results were reported by chavan and Karla (1983) [7]. The closer spaing 22.5 cm x 10 cm produced the higher haulm yield (38.82 q/ha) and biological yield (54.21 q/ha) than wider spacing of 30 cm x 15 cm and 30 cm x 10 cm. Increased biological yield in closer spacing may be attributed to higher plant population per unit area. Higher biological yield due to closer spacing was also reported by Chainyara *et al.* (2001).

Interaction
The interaction effect between genotype and spacing was absenting most of characters.

Summary and conclusion
A field investigation entitled "Assessment of groundnut genotype for plant geometry during *Kharif* season" was carried out at Agricultural college farm. Marathawada Agricultural University Parbhani (MS) during kharif season with an object to find out the suitability of newly released groundnut genotype during kharif season and to find out suitable plant geometry for these genotypes.
Groundnut genotypes:-The groundnut genotype TG-19 was superior over TAG-24 and TG-26 in various growth attributes such as plant height, number of branches, number of leaves, leaf area, number of nodules and total dry matter per plant.
Result regarding important yield attributes like number of pods /plant pod weight /plant, hundred kernel weights indicated that groundnut variety TG- 19 produced maximum yield attributes than TAG-24 and TG-26.However; there were marginal differences in TAG-24 and TG-26 genotypes. The significantly higher pod yield observed with TG-19, which was 16.95 and 22.68 % higher than TAG-24 and TG-24, respectively.
Plant geometry: Sowing of groundnut at wider spacing of 30 cm x15 cm produced notable higher values with regard all the growth attributes viz. Number of leaves, leaf area, number of branches and nodules per plant. This may be because of more space available at wider spacing. All the growth attributes recorded lower values at closer spacing of 22.5 cm x 10 cm except height of plant which was higher due to close competition within the rows and within the plant.
The yield attributing characters, number of pods per plant, pod weight per plant and shelling percentage were highest at 30 cm x 15 cm spacing compared to closer spacing of 30 cm x10 cm and 22.5 cm x 10 cm. These character were comparable between 30 cm x 10 cm and 22.5 cm x 10 cm spacing. The growth and yield attributes was significantly higher at 30 cm x 15 cm but on accounting of unit area of 1.0 ha. Producing the total population count for yield and due to this the result revealed that the sowing at 30 cm x 10 cm spacing was optimum.

Interaction
The interaction effect between genotype and spacing was above in most of the character.

Conclusion
1. Among the different groundnut genotype TG-19 was found more promising to produce higher biomass and pod yield compare to TAG-24 and TG- 26 for the cultivation during *kharif* season exposed to various biotic and a biotic stresses.
2. The spacing of 30 cm x 10 cm was found optimum to produce higher pod yield compared to wider spacing 30 cm x 15 cm as well as closer spacing 22.5cm x 10 cm.

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