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EFFECT OF SPACING AND FERTILIZER LEVELS ON *KHARIF* GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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ABSTRACT

An experiment was conducted during *kharif* season of 2022 at Bidi Tobacco Research Station, Anand Agricultural University, Anand (Gujarat) to study the effect of spacing and fertilizer levels on *kharif* groundnut (*Arachis hypogaea* L.). The soil of experiment site was loamy sand in texture with good drainage, low in organic carbon and available nitrogen, while medium in available phosphorus and medium to high in potassium. The experiment was laid out in split plot with two spacing treatments (45 cm and 60 cm) as the main plot and four NPK fertilizer levels (12.5-25-0, 12.5-25-25, 25-50-0 and 25-50-50 kg/ha) as subplots, and replicated four times. The groundnut cultivar, GG 34 sown at 60 cm and fertilized with 25-50-50 kg/ha recorded significantly higher pod yield (2330 kg/ha and 2315 kg/ha), haulm yield (4648 and 4627 kg/ha). Economically, 60 cm spacing provided the highest net realization and BCR (1.83). Among fertilizer treatments, 25-50-50 NPK kg/ha level gave the highest net return (Rs. 81,175/ha), while 25-50-0 NPK kg/ha level had the highest BCR (1.79). Nitrogen uptake from pod (86.654 kg/ha) and haulm (74.969 kg/ha) as well as phosphorous and potassium uptake from haulm (15.902 and 43.915 kg/ha) were found significantly the highest at 60 cm spacing as compared to 45 cm. Nutrient uptake by pod and haulm was significantly affected by different fertilizer levels. Application of NPK at the rate of 25-50-50 kg/ha recorded significantly higher N, P and K content in pod (3.847%, 0.619% and 1.219%) and in haulm (1.913%, 0.383% and 1.065%) respectively. Available nutrient (nitrogen, phosphorous and potassium) status of soil was not significantly affected by different spacings. Available nitrogen, phosphorous and potassium in soil were significantly differed due to application of different fertilizer levels. Application of NPK 25-50-50 kg/ha recorded significantly higher available nitrogen, phosphorous and potassium (237, 36 and 260 kg/ha) in soil after harvest. For achieving higher yields and nutrient status in soil and plant in *kharif* groundnut (GG 34), the crop should be sown at spacing of 60 cm and fertilized with 25-50-0 NPK kg/ha.
***Keywords*:** Fertilizer levels, groundnut, nutrient content, nutrient uptake, spacing.

Introduction

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop and legume grown mainly for its edible seeds. It is also known as peanut, *goober, pindar* and monkey nut (Raju, 2022). Groundnut is referred as "poor man's almond" in India (Palsande *et al*., 2019). Its seed contains high-quality of 45-50% edible oil, 25-30% digestible protein, 20% carbohydrates, 5% fiber and ash which make a sustainable contribution to human nutrition (Fageria *et al*., 1997).

Degradation of the soil, decreased productivity, and eventually food shortages are the results of long-term insufficient fertilizer application (Bagarama *et al*., 2012). Due to a number of constraints including a lack of knowledge and burdensome costs, external fertilizer use is still quite low despite significant nutrient losses

(Okello *et al.,* 2010; Angadi *et al.,* 1990). Improving agricultural productivity through better nutrient management becomes crucial in context of the world's growing population and the need to combat food insecurity (Shamsudeen *et al.,* 2011). The application of required amount of fertilizer is essential to crop growth and yield quality. As crop requires a lot of nutrients, groundnuts rapidly exhaust soil nutrients if they are not properly replenished (Aulakh *et al*., 1985).

Nitrogen is the most important plant nutrient for root and shoot growth. The creation of assimilates for growing pods, nutrient absorption, photosynthesis, vegetative and reproductive growth all depend on nitrogen. Due to their high protein content, groundnuts have a far higher nitrogen need than cereals, although soils used for groundnut cultivation are nitrogen deficient (Singh, 2004).

Phosphorus plays a crucial role in growth of legumes by encouraging widespread root development. Additionally, phosphorus application is more crucial and this element must be supplied in sufficient amounts to get better yields. Phosphorus promotes pod formation, reduces quantity of unfilled pods and promotes crop maturity (Singh, 2004).

Groundnut crop requires a significant amount of potassium, yet Indian soils typically contain a high level of potassium (Hossain and Hamid, 2007). Numerous physiological processes, including osmoregulation, cation-anion equilibrium, protein synthesis and enzyme activation need potassium. It is a significant inorganic solute that is essential to water balance of plants. Additionally, it decreases lodging, increases disease resistance and enhances agricultural yield quality and shelf life. Potassium is recognized as a significant element because of its function in crop productivity (Sakarvadia *et al*., 2019).

Spacing is a major agronomical management method and non-monetary input in increasing crop productivity. The crop planted in proper geometry maximizes the utilization of natural resources as well as agricultural inputs. Groundnut crops compete with one another both above and below ground. According to the species and area, planting geometry varies (Waghmode *et al*., 2017).

However, achieving optimal yields can be hindered by inconsistent NPK fertilizer application rates and including instances where no fertilizers are used at all by the farmers (Sai *et al*., 2024). To address these challenges and determine the most effective NPK fertilizer rates and spacing a field experiment was conducted at Anand Agricultural University, Anand.

Material and Methods

A field experiment was carried out at Bidi Tobacco Research Station, Anand Agricultural University, Anand, Gujarat, India during *kharif* season of the year 2022 on plot no. 4A. Anand is located at 45.1 m above mean sea level and is located at 22°35′ latitude and 72°56' E longitude. Anand is around 70 kilometers from the Arabian Sea shore, climate in this region is semi-arid and subtropical. The monsoon season typically lasts from the third week of June to middle of September, bringing with it an average rainfall of 864 to 870 mm, all of which is brought on by the south-west monsoon current.

The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.5), low in organic carbon (0.30%), available N (221.6 kg/ha), medium available P (31.8 kg/ha), medium available K (218.1 kg/ha). The experiment was laid out in split plot design and replicated four times. Total eight treatment combinations comprising of spacing with different levels of fertilizer were included in the experiment. Which includes two spacing *viz*., (S1) 45 cm and (S2) 60 cm as a main plot and four different fertilizer levels of NPK *viz*., (F1) 12.5-25-0 kg/ha, (F2) 12.5-25-25 kg/ha, (F3) 25- 50-0 kg/ha and (F4) 25-50-50 kg/ha as a subplot.

Observations

After harvesting, pods are separated from the plants manually and dried it completely after that pod yield was measured for each plot in kilograms and converted the yield per hectare**.** The soil samples were analyzed for available nutrients viz., N, P_2O_5 and K_2O determined as per the standard methods after harvesting. Plant samples were collected after drying. Grinding of plant sample was done for preparing fine powder to determine nitrogen, phosphorus and potassium content from plant.

Statistical analysis

Computer-based statistical analysis (BASIC) for various characters (Steel and Torrie, 1960) was done at the B. A. College of Agriculture, AAU, Anand. Wherever statistical significance was found, a crucial difference at the 0.05 level of probability was calculated for comparison. "NS" stood for non-significant comparison.

Results and Discussion

Pod and haulm yield (kg/ha)

Data presented in Figure-1 indicated that crop sown at 60 cm (S_2) spacing reported the highest pod yield (2330 kg/ha) and haulm yield (4348 kg/ha) as compared to 45 cm (S_1) spacing. These results indicated that wider spacing resulted in higher assimilation and energy production for optimum vegetative growth and yield. Similar findings are also reported by Waghmode (2017).

Significantly higher pod yield (2315 kg/ha) and haulm yield (4348 kg/ha) were found with application of fertilizer at the rate of 25-50-50 kg/ha (F_4) which is graphically depicted in Figure-1. However, it was at par with application of NPK at the rate of 25-50-0 kg/ha (F_3). Pod yield and haulm yield were increased because application of nutrients played very important role due to their synergistic effect and improved soil environment which encouraged better development of plant growth leading to higher photosynthetic activity which might lead to better development of yield attributes and finally higher pod yield and haulm yield. Similar findings are also reported by Jaiswal (2018).

Result revealed that pod yield and haulm yield of groundnut was not affected significantly due to combination of spacing and fertilizer levels.

Nitrogen content (%) and uptake (kg/ha):

An appraisal of data given in Table-1. revealed that nitrogen content in pod was failed to exert their significant effect. Numerically higher nitrogen content (3.705 %) in pod was recorded under 60 cm (S_2) spacing. However, significantly higher nitrogen uptake (86.654 kg/ha) in pod was recorded at 60 cm (S_2) spacing. Data given in Table-2 found that numerically higher nitrogen content (1.697) in haulm was observed under 60 cm (S_2) spacing. However, significantly higher nitrogen uptake (74.969 kg/ha) was recorded at 60 cm (S_2) spacing. Similar results were also found by Somesh (2019).

Data given in Table-1 revealed that application of NPK at the rate of 25-50-50 kg/ha (F_4) recorded significantly higher nitrogen content (3.847%) and uptake (89.259 kg/ha) by pod. However, it was at par with 25-50-0 kg/ha (F_3). Higher content and uptake of nutrients at higher fertilizer level might be due to increased nitrogen availability to plants resulting higher biomass production. Data given in Table-2 showed that significantly higher N content (1.913%) and uptake (89.068 kg/ha) was recorded with application of NPK at the rate of 25-50-50 kg/ha (F_4) in haulm. However, it was at par with 25-50-0 kg/ha (F_3). Higher content and uptake of nutrients due to increased nitrogen availability to plants might be resulted in higher biomass production. Similar trend was observed by Kumar (2014).

An examination of the data revealed that nitrogen content and uptake in pod and haulm were not found significant due to different combinations of spacing and fertilizer levels.

Phosphorous content (%) and uptake (kg/ha):

Data regarding phosphorous content (%) and uptake (kg/ha) by pod are given in Table- 1 were not found significant. Though numerically higher phosphorous content (0.589 %) and uptake (13.779 kg/ha) in pod were observed at 60 cm (S_2) spacing. Data presented in Table-2 revealed that numerically higher phosphorous content (0.364%) in haulm was observed under 60 cm (S_2) spacing. However, significantly higher phosphorous uptake (15.902 kg/ha) was recorded at 60 cm (S_2) spacing. Similar results were also found by Somesh (2019).

Results given in Table-1 revealed that application of NPK at the rate of 25-50-50 kg/ha (F_4) recorded significantly higher phosphorous content (0.619%) and uptake (14.342 kg/ha). This indicates that F_4 treatment was highly effective in enhancing phosphorus availability and absorption by the crop, contributing to improved nutrient dynamics in the soil and better crop performance. The results suggest that optimizing NPK levels can have a substantial impact on phosphorus utilization, which is crucial for plant growth and productivity. However, it was at par with 25- 50-0 kg/ha (F_3). Similarly, data regarding application of NPK at the rate of 25-50-50 kg/ha (F_4) recorded significantly higher phosphorous content (0.383f) and uptake (17.706 kg/ha) of haulm given in Table-2. However, it was at par with 25-50-0 kg/ha (F_3). Similar trend was observed by Sakarvadia (2019).

An appraisal of results indicated that phosphorous content and uptake due to interaction effect of spacing and fertilizer levels were not affected significantly in pod and haulm.

Potassium content (%) and uptake (kg/ha)

Data pertaining to potassium content in pod presented in Table-1 was not observed significantly. Higher potassium content (1.126%) and uptake (26.383 kg/ha) were resulted at 60 cm (S_2) spacing. The findings summarized in Table-2 revealed that higher potassium content (1.002%) in haulm was observed under 60 cm (S_2) spacing. However, significantly higher potassium uptake (43.915 kg/ha) was recorded at 60 cm (S_2) spacing. Similar results were also found by Somesh (2019).

A perusal of results presented in Table-1 revealed that application of NPK at the rate of 25-50-50 kg/ha (F_4) recorded significantly higher potassium content (1.219%) and uptake (28.341 kg/ha). This means potassium fertilizer might enhance plant utilization of nutrients and water which was reflected in a good growth and biological yield thereby increased nutrient content and uptake by groundnut. An appraisal of data given in Table-2 revealed that significantly higher potassium content (1.065%) and uptake (49.511 kg/ha) in haulm were reported by application of NPK at the rate of 25-50-50 kg/ha (F_4). This means that potassium fertilizer might enhance plant utilization of nutrients which was reflected in good growth and biological yield. Similar result was observed by Sakarvadia (2019).

The findings summarized in Table-2 indicated that potassium content (%) was significantly affected due to different combinations of spacing and fertilizer levels. Further the results shown in Table-2(a) revealed that S_2F_4 (60 cm + 25-50-50 NPK kg/ha) treatment combination reported significantly higher potassium content in haulm (1.136%) than all other treatment combinations except S_1F_2 (0.985%) and S_1F_4 (0.994%). It might be due to higher dose of NPK along with wider inter-row spacing reducing competition for the space which might increase the length and biomass of root leading to increase in nutrient uptake and ultimately increase nutrient content in the plant.

Available NPK (kg/ha)

Data regarding effect of spacing on available nitrogen (kg/ha), available phosphorous (kg/ha) and available potassium (kg/ha) in soil after harvest graphically presented in Figure-2 indicated that was found non-significant. Numerically higher available nitrogen (229 kg/ha), available phosphorous (35 kg/ha) and available potassium (247.1 kg/ha) were found at 60 cm (S_2) followed by 45 cm (S_1) spacing.

Results revealed that application of NPK at the rate of 25-50-50 kg/ha (F_4) recorded significantly higher available nitrogen (237 kg/ha) and available phosphorous (36 kg/ha) in soil after harvest of crop which is graphically presented in Figure-2. However, it was at par with 25-50-0 kg/ha (F_3). Available potassium (260 kg/ha) in soil after harvest of crop recorded significantly higher by application of NPK at rate of 25-50- 50 kg/ha (F_4) followed by 12.5-25-25 kg/ha (F_2).

Available nitrogen (kg/ha), available phosphorous (kg/ha) and available potassium (kg/ha) in soil was not significantly affected due to different combinations of spacing and fertilizer levels.

Economics:

It is cleared from the data given in Table-3 that the highest net returns (83823 Rs./ha) was secured at 60 cm (S_2) spacing compared to 45 cm (S_1) spacing. In case of BCR, higher value was recorded under 60 cm (1.83) spacing as compared to 45 cm spacing. Economical evaluation revealed that the net realization and B:C ratio increased with wider spacing (60 cm) in groundnut. It might be due to 60 cm (S_2) spacing produced maximum yield.

There was an appreciable increase in net realization due to application of various fertilizer levels as indicated in Table-3. Higher net return was obtained with application of 25-50-50 NPK kg/ha (81175 Rs./ha) while in case of BCR, higher value was recorded under application of 25-50-0 NPK kg/ha (1.79). It might be due to higher yield produced due to increased level of fertilizer application. Similar result was observed by Waghmode (2017).

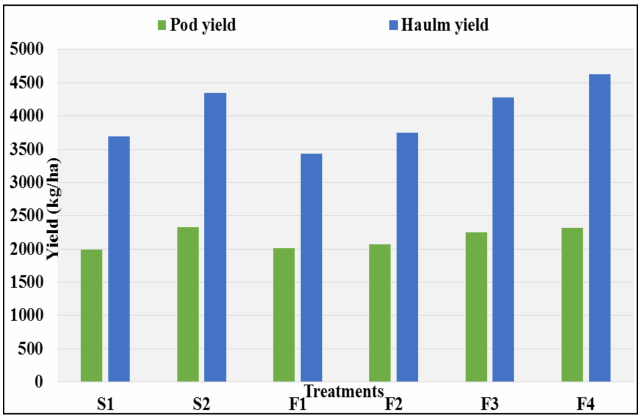

Fig. 1: Effect of spacing and fertilizer levels on pod and haulm yield of groundnut

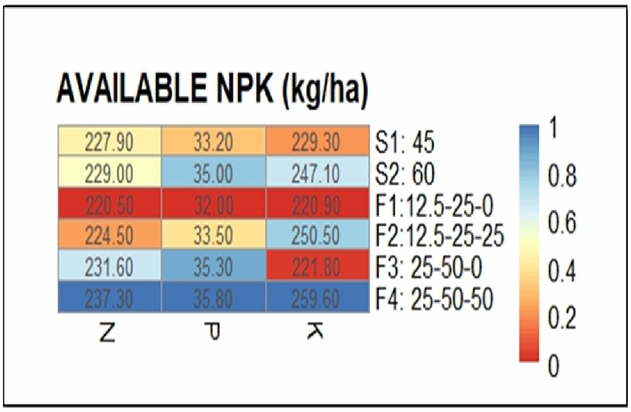

Fig. 2: Effect of spacing and fertilizer levels on available nitrogen, phosphorous and potassium in soil

Table 1: Nutrient content and uptake (N, P, K) by pod in groundnut as influenced by spacing and fertilizer levels

Treatments	Nutrient content (%)			Nutrient uptake (kg/ha)		
	N	P	K	N	P	K
A. Main Plot (Spacing) (S)						
S_1: 45 cm	3.499	0.583	1.108	70.018	11.661	22.151
S_2: 60 cm	3.705	0.589	1.126	86.654	13.779	26.383
S.Em±	0.048	0.01	0.021	2.595	0.580	1.104
C. D. at 5 %	NS	NS	NS	11.681	NS	NS
C. V. (%)	5.3	4.3	7.5	13.3	18.2	18.2
B. Sub Plot (Fertilizer Levels) (F) NPK (kg/ha)						
F_1:12.5-25-0	3.301	0.557	1.041	66.444	11.203	20.909
F_2:12.5-25-25	3.516	0.567	1.165	73.130	11.741	24.229
F_3: 25-50-0	3.743	0.601	1.043	84.511	13.594	23.590
F_4: 25-50-50	3.847	0.619	1.219	89.259	14.342	28.341
S.Em±	0.040	0.010	0.028	2.280	0.391	0.971
C. D. at 5 %	0.119	0.030	0.084	6.776	1.163	2.886
Int.Effect: S × F	NS	NS	NS	NS	NS	NS
C. V. (%)	3.1	4.4	7.2	8.2	8.7	11.3

Table 2: Nutrient content and uptake (N, P, K) by haulm in groundnut as influenced by spacing and fertilizer levels

Treatments	Nutrient content (%)			Nutrient uptake (kg/ha)		
	N	P	K	N	P	K
A. Main Plot (Spacing) (S)						
S_1: 45 cm	1.601	0.353	0.962	60.508	13.167	35.661
S_2: 60 cm	1.697	0.364	1.002	74.969	15.902	43.915
S.Em±	0.023	0.004	0.014	3.119	0.472	1.422
C. D. at 5 %	NS	NS	NS	14.038	2.123	6.401
C. V. (%)	5.7	4.8	5.1	18.4	13.0	14.3
B. Sub Plot (Fertilizer Levels) (F) NPK (kg/ha)						
F_1:12.5-25-0	1.382	0.339	0.934	47.809	11.717	32.243
F_2:12.5-25-25	1.468	0.342	0.992	55.329	12.789	37.193
F_3: 25-50-0	1.835	0.372	0.938	78.750	15.926	40.205
F_4: 25-50-50	1.913	0.383	1.065	89.068	17.706	49.511
S.Em±	0.020	0.010	0.012	2.905	0.701	1.707
C. D. at 5 %	0.060	0.014	0.036	8.631	2.083	5.071
Int.Effect: S × F	NS	NS	Sig.	NS	NS	NS
C. V. (%)	3.5	4.1	3.5	12.1	13.6	12.1

Table 2(A): Potassium content in haulm as influenced by interaction effect of spacing and fertilizer levels

	Potassium content (%)	
S × F	**S_1**	**S_2**
F1	0.925	0.943
F2	0.985	0.999
F3	0.945	0.931
F4	0.994	1.136
S.Em±	0.02	
C. D. at 5 %	0.05	
C. V. (%)	3.5	

Table 3: Effect of spacing and fertilizer levels on economics

Treatment	Yield (kg/ha)		Gross realization (Rs./ha)	Cost of cultivation (Rs./ha)	Net realization (Rs./ha)	BCR
	Pod	Haulm				
A. Main Plot (Spacing) (S)						
S_1	1996	3697	110878	45707	65171	1.43
S_2	2330	4348	129530	45707	83823	1.83
B. Sub Plot (Fertilizer Levels) (F) NPK (kg/ha)						
F_1	2010	3435	110824	43910	66914	1.52
F_2	2074	3746	114931	45443	69488	1.53
F_3	2252	4283	125454	45044	80411	1.79
F_4	2315	4627	129606	48431	81175	1.68

Conclusion

Considering results obtained from the present investigation, it could be concluded that for securing higher yield and net returns from *kharif* groundnut (GG 34), it should be sown at 60 cm distance. In case of fertilizer levels, higher yield and net returns could be obtained by application of 25-50-0 NPK kg/ha.

References

Angadi, V.V., Patil, S.V., Shilvantar, M.N. and C. B. M. (1990). Effect of NPK levels and split application of N on growth and yield of bunch groundnut in vertisol under irrigation system. *Karnataka Journal Agricultural Science*, **3**: 9-14.

Aulakh, M.S., Sidhu, B.S., Arora, B.R. and Singh, B. (1985). Content and uptake of nutrients by pulses and oilseed crops. *Indian Journal of Ecology,* **12**(2): 238-242.

Bagarama, F.M., Shenkalwa, E. and Matata, Z.P. (2012). The effect of gypsum and NPK fertiliser on groundnut performance in Western Tanzania. Third RUFORUM Biennial Meeting, 24 - 28 September, Entebbe, Uganda. 389-394.

Fageria, N.K., Baligar, V.C. and Jones, C. (1997). Growth and mineral nutrition of field crop. Marcel Dakker. Inc, New York, 1001.

Hossain, M.A. and Hamid, A. (2007). Influence of N and P fertilizer application on root growth, leaf photosynthesis and yield performance of groundnut. *Bangladesh Journal of Agricultural Research*, **32**(3), 369-374.

Jaiswal, A.B., Gourkhede, P. H. and Narale, S.H. (2018). Studies of different plant geometry on yield and quality of groundnut genotypes drought prone area of Marathwada region. *International Journal of Chemical Studies*, **6**(2): 312-316.

Kumar, L.S., Radder, B.M., Malligawad, L.H. and Manasa, V. (2014). Effect of nitrogen and phosphorus levels and ratios on yield and nutrient uptake by groundnut in northern transition zone of Karnataka. *The Bioscan*, **9**(4): 1561-1564.

Okello, D.K., Biruma, M. and Deom, M.C. (2010). Overview of groundnuts research in Uganda: Past, present and future. *African Journal of Biotechnology*, **9**: 6448-6459.

Palsande, V.N., Nagrale, M.R., Kasture, M.C., Gokhale, N.B., Dhekale, J.S. and Salvi, V.G. (2019). Growth, yield and quality of *Kharif* groundnut (*Arachis hypogaea* L.) as affected by different levels of nitrogen, potassium and zinc in lateritic soils of Konkan. *Journal of Pharmacognosy and Phytochemistry*, **8**(5): 790-794.

Raju, G. V., Umesha, C., Reddy, S.M. and Krishna, P.V. (2022). Effect of spacing and organic manures on growth and yield of groundnut (*Arachis hypogaea* L.). *The Pharma Innovation Journal*, **11**(3): 291-294.

Sai, R. and Paswan, S. (2024). Influence of higher levels of NPK fertilizers on growth, yield, and profitability of three potato varieties in Surma, Bajhang, Nepal. *Heliyon*, **10**(14).

Sakarvadia, H. L., Vekaria, L.C., Ponkiya, H.P., Vaghasia, P.M. and Polara, K.B. (2019). Potassium fertilization to *kharif* groundnut in medium black calcareous soils of Saurashtra region of Gujarat. *Journal of Chemical Studies*, **7**(4): 1752-1755.

Singh, A.L. (2004). Mineral nutrient requirement, their disorders and remedies in groundnut. *Groundnut Research in India,* 137-159.

Shamsudeen A., Donkoh S.A. and S. G. (2011). Technical efficiency of groundnut production in West Mamprusi District of Northern Ghana. *Journal of Agriculture and Biological Sciences*, **2**(4): 071-077

Somesh, N. B. (2019). Studies on crop geometry and nutrient management in summer groundnut (*Arachis hypogaea* L.) for higher productivity and profitability. (Master’s thesis, Junagadh Agricultural University, Junagadh).

Steel, R.G.D. and Torrie, J.H. (1960). Principles and procedures of statistics. Principles and procedures of statistics.

Waghmode, B.D., Kambale, A.S., Navhale, V.C., Chendge, P.D. and Mahadkar, U.V. (2017). Effect of plant population and fertilizer doses on yield attributes, yield and economics of summer groundnut. *International Journal of Current Microbiology and Applied Sciences*, **6**(11): 2670-2675.