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Effect of spacing and organic manures on growth and yield of groundnut (*Arachis hypogaea* L.)

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Abstract
The field experiment was entitled "Effect of spacing and organic manures on growth and yield of kharif groundnut (*Arachis hypogea* L.)" conducted during Kharif 2021. Department of Agronomy, SHUATS, Prayagraj (U.P). The treatment consisted of spacing (30 × 10 cm, 35 × 10 cm, 40 × 10 cm) and organic manures (2.5t/ha vermicompost, 2t/ha farm yard manure, 1.5t/ha vermicompost + 1.5t/ha farm yard manure) *viz*. whose effect is observed on groundnut (var. Kadiri 1812). The experiment was laid out in Randomized Block Design, nine treatments replicated thrice. Plant height (62.91 cm), number of nodules (92.00), dry weight (53.69 g/plant), No. of pods/plant (23.53), no. of kernels/pod (2.00), harvest index (51.62%), kernel yield (2917.33 kg/ha), haulm yield (2698 kg/ha) were significantly influenced with treatment combination of 35 × 10 cm spacing + 2.5t/ha vermicompost. Maximum CGR (31.10 g/m²/day) were recorded with application of 30 × 10 cm spacing + 2.5t/ha vermicompost. However, RGR and seed index were found to be non- significant. Therefore, treatment combination of 35 × 10 cm spacing + 2.5t/ha vermicompost was most productive and cost effective.

Keywords: Vermicompost, farm yard manure, spacing, groundnut

Introduction
Groundnut (*Arachis hypogaea* L.) is an important oil seed crop and a grain legume and grown mainly for its edible seeds. It is also known as peanut, goober, Pindar, monkey nut. India is the second largest producer of groundnut after China. Groundnut is the largely produced oil seed in India; it is also an important cash crop. It is classified as both a grain legume and, due to its high oil content, an oil crop. Groundnut belonging to family leguminaceae is the fourth most important source of edible oil also known as "The King of Oilseeds" and third most important source of vegetable protein. It contributed to sustainable agriculture being a legume and is cultivated in both kharif and zaid by farmers. India's groundnut cropping area for the year 2020 was estimated to be 50.95 lakh hectares and the production 37.70 lakh tonne. Groundnut is primarily used for extraction of oil, with an analysis of about 46.70% - 50%. It is also consumed directly because of its high food value, which is again due to its higher content of protein (22.0%), carbohydrate (10.0%) and minerals (3.0%), niacin (17mg/100g) (Rajagopal *et al*., 2000) Every year many high yielding new varieties of the groundnut were developed which are resistant to different stress conditions like drought, salinity, highly responsive to fertilizer application and also resistant to different pests and diseases. Among the factors limiting pod yield of groundnut in many areas is inadequate plant population and nutrition. Therefore, optimum plant population is essential to get good yields. Groundnut plays an important role in dietary requirements of women and children. Haulm is used as livestock feed. Groundnut oil is composed of mixed glycerides and contains a high proportion of unsaturated fatty acids *viz*., oleic (50 to 65%) and linoleic acid (18 to 30%). Groundnut contains amino acids including cysteines which are essential for animal growth. The groundnut cake obtained after oil extraction is rich in protein and considered as valuable organic manure and animal feed, which contains 7 to 8% N, 1.5% P and 1% K. Being a leguminous crop groundnut helps in maintenance of soil fertility. And being rich in protein they supply major share of protein requirement of country. The urgency for higher agricultural production and the greed for higher profits have made nutrient application in agriculture, unscientific with more wastage leading to pollution of soil, water and air. Farm yard manure is mainly to replenish and keep soil humus status and maintain the optimum conditions for the activities of soil microorganisms. Effects of applied vermicompost on soil environments probably hasten germination and vigour of seedlings thereby promoting early emergence.

Application of vc had a positive impact on germination and seedling emergence, which may be attributable to high porosity, aeration, water holding capacity and presence of growth promoting susbstances (Arancon *et al*., 2004). Among the various factors that influence the yield of peanut, population with proper row spacing is very important. Planting density is one of the main factors that plays an important role on growth, yield and quality of peanut too. Nimje (1996) reported that accumulation of plant dry matter and branch formation were found to be greater and yield attributes like pod/plant, yield/plant and 1000-grain weight were the highest when the crop is grown with proper spacing. Optimum spacing ensures proper growth of the aerial and underground parts of the plant through efficient utilization of solar radiation, nutrients, water, land as well air spaces (Miah *et al*., 1990). The use of proper row spacing to get appropriate plant stand is a pre-requisite for higher crop yield per unit area. In order to economize and popularize summer groundnut cultivation for such a large community, research on low-cost production technology carries great importance. Partha Sarathi (2012) [38] reported that the application of 2.5t/ha vermicompost resulted in highest plant height (48.1 cm) and highest pods/plant (41.00), no. of branches/plant (6.3), compairing with the application of fym 10t/ha plant height (42.00 cm) and highest pods/plant (33.3), no. of branches/plant (4.7), highest pod yield (1960 kg/ha) and haulm yield (2122 kg/ha). Pattanayak *et al*. (2011) reported that combined application of FYM (2 t/ha) and lime with 50 per cent of recommended NPK increased groundnut pod yield by 18.4 per cent (2000 kg ha1) compared to 100 per cent NPK alone (1690 kg ha-1). No significant yield difference was observed between 100 per cent and 50 per cent of soil test based nutrient application when applied in combination with lime or lime + FYM. Bekel *et al*. (2019) [9] reported that the application of 2.5 t/ha vc reported that plant height (26.8), number branches (6.4) per plant, and total number of nodules per plant (36.1), and total number of matured pods per plant (28.8), seed yield (2.11 t/ha), shelling percentage (%) and 100 seeds weight were significantly higher. Awal and Aktar (2015) [21] experimenting with five row spacings *viz*. 15, 20, 25. 30 and 35 cm opined that row spacings had significant effect on growth and yield contributing characters such as plant height, number of branches plant, leaf area index, dry matter accumulation, pod plant, 1000-seed weight, pod or seed yield, biological yield and harvest index. It is evident that crop stature increased due to the closing of row spacing from 35 to 15 cm, but the number of branches plant was decreased. Crops grown with wider row produced larger number of pod plant, heavier seed and higher harvest index. Wider row spacing (i.e., 35 cm) although facilitated to accumulate larger dry matter plant however greater accumulation of biomass per unit of land was occurred at 20 cm inter row distance.

Materials and Methods

The field experiment was entitled "Effect of spacing and organic manures on growth and yield of kharif groundnut (*Arachis Hypogea* L.)" conducted during Kharif 2021. Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), low in organic carbon (0.345%), available N (69.34 kg/ha), available P (21.4 kg/ha), available K (212.3 kg/ha) and available Sulphur (13.53 ppm). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. The Treatments were T1: 30 × 10 cm + 2.5t/ha Vermicompost; T2: 35 × 10 cm + 2.5t/ha Vermicompost; T3: 40 × 10 cm + 2.5t/ha Vermicompost; T4: 30 × 10 cm + 2.5t/ha Farm yard manure; T5: 35 × 10 cm + 2.5t/ha Farm yard manure; T6: 40 × 10 cm + 2.5t/ha Farm yard manure; T7: 30 × 10 cm + 1.5t/ha Vermicompost + 1.5t/ha Farm yard manure; T8: 35 × 10 cm + 1.5t/ha Vermicompost + 1.5t/ha Farm yard manure; T9: 40 × 10 cm + 1.5t/ha Vermicompost + 1.5t/ha Farm yard manure. Five random plants were selected from each plot to record observations on plant growth attributes. Similarly, five random plant samples were collected from each plot at the time of harvest for recording observations on plant yield attributes. Experimental data collected was subjected to statistical analysis by adopting Fisher's method of Analysis of Variance (ANOVA) as outlined by Gomez and Gomez (2010). Critical Difference value were calculated whenever the 'F' test was found significant at 5% level.

Results and Discussion

Plant height of groundnut increased towards maturity with proper spacing and vermicompost. The significantly higher plant height (38.04 cm) was observed in treatment with application of 2.5t/ha vermicompost and spacing 35 × 10 cm treatment, which was statistical at par with T1 and T3 treatment. The significantly higher dry weight (30.00 g/plant) was obtained from spacing 35 × 10 cm and application of 2.5t/ha vermicompost treatment, which was statistically at par with T1 and T3 treatments. Number of nodules per plant was also increased with increasing spacing of 35 × 10cm + 2.5t/ha vermicompost, significantly higher number of nodules per plant (92.00), which was statistically at par with treatment T1. It may be due to the vermicompost enhance the growth of nitrogen fixing microorganism and phosphate solubilizing microorganisms in the rhizosphere. It may enhance the growth as well as the nutrient in the plant.

Table 1: Effect of Spacing and Organic manure on growth attributes of groundnut.

Treatments	At 60 DAS Plant height (cm)	no. of nodules/plant	Dry weight(g/plant)	CGR
30 × 10 cm + 2.5t/ha [VC]	37.66	89.44	29.40	31.10
35 × 10 cm + 2.5t/ha [VC]	38.04	92.00	30.00	27.53
40 × 10 cm + 2.5t/ha [VC]	37.34	85.67	28.76	22.46
30 × 10 cm + 2t/ha [FYM]	35.34	80.44	27.44	28.44
35 × 10 cm + 2t/ha [FYM]	35.89	80.67	27.40	24.62
40 × 10 cm + 2t/ha [FYM]	35.31	80.11	27.12	21.15
30 × 10 cm + 1.5t/ha [VC] + 1.5t/ha [FYM]	36.16	82.78	27.82	29.78
35 × 10 cm + 1.5t/ha [VC] + 1.5t/ha [FYM]	36.07	84.56	28.23	25.50
40 × 10 cm + 1.5t/ha [VC] + 1.5t/ha [FYM]	36.07	81.67	27.83	21.97
F test	S	S	S	S
Sem	0.45	0.92	0.58	0.90
CD (p=0.05%)	1.35	2.76	1.75	2.70

The vermicompost assists in introducing the microorganisms into the rhizosphere of plants, helping to increase the N and P availability by making available biologically fixed N and biologically solubilizer P was attributed to the intimate mixing of ingested particles with soil in vermicompost

(Mackey *et al*., 1982) [28]. Significantly higher CGR (31.10 g/m^2/day) was obtained from spacing 30 × 10 cm and application of 2.5t/ha vermicompost treatment, which was statistically at par with T4 and T7 treatments. Increasing plant density tended to decrease crop growth rate per plant, pod growth rate per plant and to increase leaf area index and crop growth rate per unit area. Increasing plant density decreased harvest index, Plant density also affected the proportion of yield on main stems and different branches (Mishra *et al*., 1998) [27]. The results of this study are consistent with those of Madisa *et al*. (2014), who found that taller plants were collected at wider spacing due to less competition for resources such as nutrients. Aliyu (2019) found out that the varieties behaved significantly (p<0.001) differently at all stages of the crop's growth in terms of plant height. This may be attributed to the genetic differences between the respective cultivars.

Yield Attributes

Number of pods/plant (23.53), seed yield (2917.33 kg/ha), haulm yield (2698 kg/ha), harvest index (51.62) were significantly higher with the spacing of 35 × 10 cm + 2.5t/ha vermicompost was statistically at par with the treatment T1. Seed index was (36.34) was higher and there was no significant change in between the treatments. This might be due to large availability of nutrients which in turn promoted growth as well as yield attributing characters. Further, physiological role of N and P supplied by FYM and compost in enhancing growth parameters might have led to increased yield attributes and there by yield of crop at application of organic manure. This is attributed to better growth of plants and higher yield by slow release of nutrients for absorption with additional nutrients like gibberellins, cytokinin, and auxins, by the application of organic inputs. These findings are in accordance with the findings of Ola *et al*., 2013 [32].

Table 2: Effect of Yield attributes in Ground nut as influenced by Spacing and Organic manure.

Treatments	No. of pods/ (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)	Plant	Seed index	Seed yield
30 × 10 cm + 2.5t/ha [VC]	23.47	33.73	2750.40	2661	50.49	
35 × 10 cm + 2.5t/ha [VC]	23.53	36.34	2917.33	2698	51.62	
40 × 10 cm + 2.5t/ha [VC]	23.40	34.68	2540.80	2565	49.73	
30 × 10 cm + 2t/ha [FYM]	19.47	31.11	2188.80	2240	49.22	
35 × 10 cm + 2t/ha [FYM]	19.47	30.56	2226.13	2200	50.23	
40 × 10 cm + 2t/ha [FYM]	19.27	30.99	2069.33	2066	49.99	
30 × 10 cm + 1.5t/ha [VC]+1.5t/ha [FYM]	20.07	32.55	2256.00	2358	48.77	
35 × 10 cm + 1.5t/ha [VC]+1.5t/ha [FYM]	21.07	34.31	2257.60	2384	48.51	
40 × 10 cm + 1.5t/ha [VC]+1.5t/ha [FYM]	19.60	34.12	2137.07	2309	47.91	
F test	S	NS	S	S	S	
S.Em	0.64	1.26	65.07	13.24	0.70	
CD (p=0.005%)	1.92	-	270.24	39.7	2.10	

Conclusion

It is concluded that for obtaining highest yield in groundnut during *kharif* season, application of 2.5 t/ha (vermicompost) at 35 × 10 cm spacing (Treatment 2) recorded higher plant height, number of nodules, dry weight, more number of pods per plant, number seeds per pod, seed yield, haulm yield.

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