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Effect of Spacing and Varieties on Growth, Yield and Economics of Summer Groundnut (*Arachis hypogea* L.)

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ABSTRACT: The field experiment was conducted at Crop Research Farm during *Zaid* season 2022, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) to study the effect of Spacing and Varieties on Growth, Yield and Economics of Summer Groundnut. The results showed that treatment 9 [Kadiri-6 + Spacing (30 cm × 10 cm)] recorded significantly higher plant height (43.48 cm), maximum number of nodules/plant (46.53), higher plant dry weight (25.39 g/plant), and yield attributes namely higher number of pods/plant (21.13), higher number of kernals/pod (2.01), higher seed index (36.77 g), higher seed yield (2.27 t/ha), higher haulm yield (4.44 t/ha) and higher harvest index (39.23 %) compared to other treatment combinations. The maximum gross returns (1,26.920 INR/ha), maximum net returns (86,692.00 INR/ha) and highest benefit cost ratio (2.15) was also recorded in treatment 9 [Kadiri-6 + Spacing (30 cm x 10 cm)] when compared to other treatments.

Keywords: Groundnut, Spacing, Varieties, Growth, Yield and Economics.

INTRODUCTION

Groundnut is an important crop due to their high protein (26%), soluble carbohydrate (24%-22%), and mineral content. Hydrogenated vegetable oil makes up between 45.1% and 51.1% of this product. Because of its adaptability, it may be found in a wide variety of products, from shampoo and soap to food and even construction materials. Being the principal source of animal feed and with a high protein content (46%), peanuts are also a valuable source of manure. Calves may like munching on haulms since they are high in protein (around 10% to 12%) and taste well (Patil *et al.,* 2007). While groundnut oil contains several unsaturated fatty acids, oleic acid (50-65%) and linoleic acid (18-30%) make up the bulk of these fats. Groundnuts may contain the amino acid cysteine, which is crucial for protein synthesis. The high protein content of groundnut cake makes it a valuable organic waste and animal feed. There might be anything from 8% to 1% nitrogen, 1.5% to 1% phosphorus, and 8% potassium (Dileep *et al.,* 2021).

Groundnut ranks first in area and second in terms of production after soyabean and is grown in almost all parts of the country over wide range of agro- climatic condition. Globally, groundnut covers 315 lakh hectares with the production of 536 lakh tonnes with the productivity of 1701 kg/ha (FAOSTAT, 2020). In India, groundnut is grown over an area about 55.71 lakh ha with a production of 102.10 lakh tonnes and productivity of 1671 kg/ha under 2020-21(GOI, 2020). During 2019-20 total area coverage under groundnut in Uttar Pradesh 93822.00 hectares with a production of 88371 tonnes and the productivity 940 kg/ha (DAC, 2020). According to government fourth advance estimates groundnut production in 2021-22 is at 101.06 lakh tonnes.

The quality of a harvest may be affected by both natural and human-caused factors. If the crop is given the attention it requires, its quality may even rise. Plants need enough room to grow. Improving crop yields is essential, and there are several no-cost agronomic management strategies that may be used. Plant density is the ratio of plant cover to the total area. Maintaining the necessary plant population and participating in intercultural activities to get a higher yield are both dependent on having enough spacing in line planting. The physiological processes of the crop may be disrupted if the plants were too close together or too far apart. When there are too many plants in an area, they will fight tooth and nail for food and water. Increasing or lowering spacing has the same negative effect on production since both strategies result in the loss of planting space. The connection between plant density and seed production may be sumarised in two ways. The best use of your land and resources may be made if you cultivate the right crop. When your crop is fully grown, its canopy should be thick enough to block off more than 95% of the light. Plants with uniform spacing may produce more seeds because they face less competition from their neighbours (Awal and Aktar 2015).

The main problems limiting production of peanut are poor cultural practices and inadequate weed

management. Groundnut cannot compete effectively with weeds, particularly 3–6 weeks after sowing; therefore, early removal of weeds is important before flowering and during pegging (Page *et al.,* 1982). If early weeding is done well and crop spacing recommendations followed, then the weeds that come up later are smothered with the vigorous growth of the crop. Once flowering and pegging begins it is advisable to weed by hand pulling rather than by using a hoe and this is less likely to disturb any developing pods (Hama Kareem *et al.,* 2016).

The summer groundnut has become increasingly popular as it is an ideal season by keeping in view crops requirement of sunshine and high temperature. Also, the crop gives three times higher yield than that of kharif. 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 (Gadade *et al.,* 2018).

A diverse range of seed types is essential for effective groundnut cultivation. For the first time ever, the nation is on the verge of groundnut self-sufficiency because to the increased adoption of high-yielding cultivars in recent years. Planting a certain variety at the optimal population density (in terms of unit area/hectare) for the given location might help save expenses and maximise returns (Dileep *et al.,* 2021). Optimum plant population and plant spacing and varieties are the main factors for getting more seed yield of groundnut. Keeping in view abouts facts, the present study was undertaken to find out effect of spacing and varieties on growth, yield and economics of summer groundnut (*Arachis hypogea* L.).

MATERIALS AND METHODS

The field experiment was conducted during the *Zaid* season of 2022, at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj, (U.P.). The soil of the field constituting a part of central gangetic alluvium is deep and neutral. The soil of the experiment field was sandy loam in texture, nearly neutral in soil reaction (pH 7.8), low level of organic carbon (0.62%), available N (225 kg/ha), P (38.2 kg/ha) and K (240.7 kg/ha). The treatment consists of three different row spacing of (20 cm × 10 cm), (25 cm × 10 cm) and (30 cm × 10 cm) and with combination of 3 varieties *viz.,* Kadiri Amaravathi, Dharani and Kadiri-6. The experiment was laid out in Randomized Block Design (RBD) with 9 treatments each replicated thrice. The treatment combinations are T_1 –[Kadiri Amaravathi + Spacing (20 cm × 10 cm)], T_2 –[Kadiri Amaravathi + Spacing (25 cm × 10 cm)], T_3 – [Kadiri Amaravathi + Spacing (30 cm × 10 cm)], T_4 –[Dharani + Spacing (20 cm × 10 cm)], T_5- [Dharani + Spacing (25 cm × 10 cm)], T_6 –[Dharani + Spacing (30 cm × 10 cm)], T_7 –[Kadiri-6 + Spacing (20 cm × 10 cm)], T_8 –[Kadiri-6 + Spacing (25 cm × 10 cm)], T_9–[Kadiri-6 + Spacing (30 cm × 10 cm)]. Data recorded on different aspects of crop, *viz.,* growth, yield attributes and yield were subjected analysis by analysis of variance method (Gomez and Gomez 1976).

RESULT AND DISSCUSSION

A. Growth parameters

Plant height (cm). The data revealed that significantly higher plant height (43.48 cm) was recorded in the treatment 9 [(Kadiri-6 + Spacing (30 cm × 10cm)]. However, treatment 6 [(Dharani + Spacing (30 cm × 10cm)] was found statistically at par with treatment 9 [(Kadiri-6 +Spacing (30 cm × 10 cm)] (Table 1). Significant and higher plant height was observed with the spacing (30 cm × 10 cm) which might be due to that wider spacing gave the opportunity for all the resources to be available readily to the individual plants such as nutrients, light, space, moisture and thus resulting in higher growth rate of the plant. Similarly, results were also reported by Ngala *et al.* (2013); Kithan and Singh (2017) in sesame.

Number of nodules/plant. The data showed that significantly higher number of nodules/plant (46.53) was recorded in the treatment 9 [(Kadiri-6 + Spacing (30 cm × 10 cm)]. However, treatment 6 [(Dharani + Spacing (30 cm × 10 cm)] was found statistically at par with treatment 9 [(Kadiri-6 + Spacing (30 cm × 10 cm)] (Table 1). Because of increased availability to growth nutrients and more effective use of those resources throughout the crop's development, the spacing (30 cm × 10 cm) resulted in much more nodules/plants. These results were corroborated by Birendra *et al.* (2017).

Plant dry weight (g/plant). The data recorded that significantly higher plant dry weight (25.39g) was recorded in the treatment 9 [(Kadiri-6 + Spacing (30 cm × 10 cm)]. However, treatment 6 [(Dharani + Spacing (30 cm × 10 cm)] were found statistically at par with treatment 9 [(Kadiri-6 + Spacing (30 cm × 10 cm)] (Table 1). Significant and higher plant dry weight was observed with the spacing (30 cm × 10 cm) which might be due to the production increased steadily with advancing growth stages and reached the maximum at harvest results in higher dry weight of the plant. Similar results were also reported by Varshitha *et al.* (2022).

Crop Growth Rate (g/m^2/day). Results showed that maximum crop growth rate (23.26 g/m^2/day) was recorded in treatment 7 [Kadiri-6 + Spacing (20 cm × 10 cm)]. There is no significant difference between the treatments (Table 1).

Relative Growth Rate (g/g/day). The data revealed that significantly higher relative growth rate (0.021 g/g/day) was recorded in treatment 2 [Kadiri Amaravathi + Spacing (25 cm × 10 cm)]. However, the treatment 1[adiri Amaravathi + Spacing (20 cm × 10 cm)], treatment 3 [Kadiri Amaravati + Spacing (30 cm × 10 cm)], treatment 5 [Dharani + Spacing (25 cm × 10 cm)], treatment 6 [Dharani + Spacing (30 cm × 10 cm)], treatment 7 [Kadiri-6+ Spacing 20 cm × 10 cm)] and treatment [Kadiri-6 + Spacing (25 cm × 10 cm) were found statistically at par to the treatment 2 [Kadiri Amaravathi + Spacing (25 cm × 10 cm)] (Table 1). Significant and higher relative growth rate was recorded with the spacing (30 cm × 10 cm) which might be due to the result enhanced metabolic activities and photosynthetic rate resulting in

improvement in the accumulation of dry matter at the successive growth stages further leads to increase the crop and relative growth rate in all stages of plants. Similar findings were also reported by Sarkar and Banik (2002).

B. Yield Attributes

Number of pods/plant. Significantly and maximum number of pods/plant (21.13) was recorded in the treatment 9 [Kadiri-6 + Spacing (30 cm × 10 cm)]. However, treatment 2[Kadiri Amaravati + Spacing (25 cm × 10 cm)], treatment 3 [Kadiri Amaravati + Spacing (30 cm × 10 cm)], treatment 5 [Dharani + Spacing (25 cm × 10 cm)], treatment 6 [Dharani + Spacing (30 cm x 10 cm)] and treatment 8 [Kadiri-6 + Spacing 25 cm × 10 cm) was found to be statistically at par with treatment 9 [Kadiri-6 + Spacing (30 cm × 10 cm)] (Table 2). Significant and maximum number of pods/plant was recorded with the spacing (30 cm × 10 cm) which might be due to the sufficient space between rows which encouraged more plants and also lesser interplant competition for space, light, nutrient and moisture. Similar results were also reported by Chandrasekaran *et al.* (2007).

Number of kernals/pod. Significant and higher number of kernels/pod (2.01) was recorded in the treatment 9 [Kadiri-6 + Spacing (30 cm × 10 cm)]. However, the treatment 6 [Dharani + Spacing (30 cm × 10 cm)] was found to be statistically at par with treatment 9 [Dharani + Spacing (30 cm × 10 cm)] (Table 2). Significant and maximum number of kernels/pods was recorded with the spacing (30 cm × 10 cm) which might be due to wider spacing plants have more space to grow vigorously and produced lengthy pods, which contained more seeds. Similar results were also agreed by Shaukat *et al.* (2012); Idris (2008).

Seed index (g). Significant and maximum seed index (36.77 g) was recorded in the treatment 9 [Dharani + Spacing (30 cm × 10 cm)]. However, the treatment 6 [Dharani + Spacing (30 cm × 10 cm)] which was found to be statistically at par with the treatment 9 [Dharani + Spacing (30 cm × 10 cm) (Table 2). The maximum seed index was observed with the spacing (30 cm × 10 cm) which might be due to wider spacings provides more soil space for growth and development due to less plant competition both above and below the ground resulted better proliferation and higher canopy development which finally results in higher nutrients up take, seed filings and more seed weight. Similar results were also reported by Singh *et al*. (2021).

Seed yield (t/ha). Significant and maximum seed yield (2.27 t/ha) was recorded in the treatment 9 [Dharani + Spacing (30 cm × 10 cm)]. However, there was no statistically at par values found among all the treatments (Table 2). Significant and higher seed yield was observed with the spacing (30 cm × 10 cm) which might be due to the better spacing making water and nutrients more easily accessible to the plants. Plants were able to reach their full growth potential and produce a higher yield because to increased surface area exposed to air, better cultural practises, and more efficient weed management. These findings were also corroborated by Meena *et al*. (2011).

Haulm yield (t/ha). The significant and higher haulm yield (4.44 t/ha) was recorded in the treatment 9 [Dharani + Spacing (30 cm × 10 cm)]. However, the treatment 6 [Dharani + Spacing (30 cm × 10 cm)] was found to be statistically at par to treatment 9 [Dharani + Spacing (30 cm × 10 cm)] (Table 2). The significant and maximum haulm yield was observed in spacing (30 cm × 10 cm) which might be due to optimum row spacing have effectively utilized the growth resources, particularly solar radiation. Similar results were also agreed by Bhairappanavar *et al.* (2005); Murade *et al.* (2014).

Harvest Index (%). Highest harvest index (39.28 %) was recorded in the treatment 3 [Kadiri Amaravathi + Spacing (30 cm × 10 cm)] (Table 2). There was no significant difference between the treatments.

Economics. The maximum gross returns (1,26.920 INR/ha), maximum net returns (86,692.15 INR/ha) and highest benefit cost ratio (2.15) was recorded in treatment 9 (Kadiri-6 + Spacing (30 cm × 10 cm) (Table 3). Significant and higher gross returns, net returns and benefit cross ratio was recorded with the treatment 9 [Kadiri-6 + Spacing (30 cm ×10 cm)] which might be due to the varieties and spacing was found to be the best confectionery groundnut for getting higher yield and returns. Similar results were also reported by Chandrasekaran *et al*. (2007).

Table 1: Effect of Spacing and Varieties on growth attributes of Summer Groundnut.

Treatments	60-80 DAS			60-80 DAS	
	Plant height (cm)	Number of nodules/plant	Plant dry weight (g/plant)	CGR (g/m^2/day)	RGR (g/g/day)
1. Kadiri Amaravathi+ Spacing 20 cm × 10 cm	36.23	41.59	20.45	22.76	0.019
2. Kadiri Amaravathi + Spacing 25 cm × 10 cm	38.60	43.17	22.59	21.92	0.021
3. Kadiri Amaravathi + Spacing 30 cm × 10 cm	40.18	45.36	24.18	21.21	0.019
4. Dharani + Spacing 20 cm × 10 cm	37.29	42.10	23.29	17.01	0.014
5. Dharani + Spacing 25 cm × 10 cm	39.35	43.99	23.22	21.21	0.020
6. Dharani + Spacing 30 cm × 10 cm	42.72	46.10	24.94	20.5	0.018
7. Kadiri-6 + Spacing 20 cm × 10 cm	37.71	42.50	21.64	23.26	0.019
8. Kadiri-6 + Spacing 25 cm × 10 cm	39.89	44.33	23.88	19.90	0.018
9. Kadiri-6 + Spacing 30 cm × 10 cm	43.48	46.53	25.39	17.28	0.017
F test	S	S	S	NS	S
SEm (+)	0.33	0.17	0.41	2.30	0.009
CD(P=0.05)	0.98	0.51	1.25	6.92	0.003

Table 2: Effect of Spacing and Varieties on yield and yield attributes of Summer Groundnut.

Treatments	Number of pods/plant	Number of kernels/pod	Seed index (g)	Seed yield (t/ha)	Haulm yield (t/ha)	Harvest index (%)
1. Kadiri Amaravathi + Spacing 20 cm × 10 cm	16.56	1.55	31.58	1.58	3.67	39.63
2. Kadiri Amaravathi + Spacing 25 cm × 10 cm	18.13	1.68	33.87	1.79	4.04	39.54
3. Kadiri Amaravathi + Spacing 30 cm × 10 cm	19.59	1.87	35.41	1.93	4.32	39.94
4. Dharani + Spacing 20 cm × 10 cm	17.58	1.58	32.10	1.68	3.85	39.03
5. Dharani + Spacing 25 cm ×10 cm	19.00	1.78	34.53	1.85	4.17	39.19
6. Dharani + Spacing 30 cm × 10cm	20.54	1.96	36.23	2.04	4.37	39.06
7. Kadiri-6 + Spacing 20 cm × 10 cm	14.61	1.63	32.43	1.76	3.93	39.30
8. Kadiri-6 + Spacing 25 cm × 10 cm	19.14	1.83	35.27	2.14	4.26	39.43
9. Kadiri-6 + Spacing 30 cm × 10 cm	21.13	2.01	36.77	2.27	4.44	39.28
F test	S	S	S	S	S	NS
SEm (+)	1.12	0.02	0.18	0.01	0.21	0.19
CD(P=0.05)	3.37	0.06	0.54	0.11	0.06	0.58

Table 3: Effect of Varieties and Spacing on the Economics (INR) of Summer Groundnut.

	Treatment combinations	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio
1.	Kadiri Amaravathi+ Spacing 20 cm × 10 cm	43,827.15	83,180	39,352.15	1.09
2.	Kadiri Amaravathi + Spacing 25 cm × 10 cm	41,777.15	94,000	52,222.85	1.25
3.	Kadiri Amaravathi + Spacing 30 cm × 10 cm	39,727.15	101,280	61,552.85	1.54
4.	Dharani + Spacing 20 cm × 10 cm	42,927.15	91,700	48,772.85	1.13
5.	Dharani + Spacing 25 cm × 10 cm	41,027.15	100,840	59,812.85	1.45
6.	Dharani + Spacing 30 cm × 10 cm	39,127.15	110.740	71,612.85	2.01
7.	Kadiri-6 + Spacing 20 cm × 10 cm	44,577.15	99,380	54,802.85	1.22
8.	Kadiri-6 + Spacing 25 cm × 10 cm	42,402.15	119,800	77,397.85	1.82
9.	Kadiri-6 + Spacing 30 cm × 10 cm	40,227.15	126,920	86,692.15	2.15

CONCLUSIONS

Based on above findings it can be concluded that combination of Kadiri-6 along with the spacing (30 cm × 10 cm) (Treatment 9) was observed highest seed yield and benefit cost ratio.

FUTURE SCOPE

Further scope for experiment can be carried on the basis of availability of land and varieties to see how spacing affect the crop growth and yield.

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Conflict of Interest. None.

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