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Response of Summer Groundnut Varieties as Influenced by Plant Geometry

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Zaid* 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.) to study the "Response of summer Groundnut varieties as influenced by plant geometry". The experimental treatments comprised of three types of Groundnut varieties *vi,* Kadiri-6, TAG-24, Kadiri Amaravathi and three different planting geometry *viz*, 30 cm x 15 cm, 35 cm x 15 cm, 45cm x 10 cm, forming total 9 treatment combinations each was replicated thrice and laid out in randomized block design. The results showed that the significantly highest plant height (37.78cm), maximum number of nodules/plant (125.77), highest plant dry weight (22.37 g), maximum number of pods/plant (30.20), maximum number of kernels/pod (1.50), higher seed index (32.20 g), higher seed yield (2.19 t/ha), higher haulm yield (5.20 t/ha), and higher harvest index (35.86%), shelling percentage (55.97%)was recorded in treatment 7 [Kadiri Amravati+ Spacing (30 cm x 15 cm)]. Similarly, maximum gross return (141650.00 INR/ha), net return

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(97386.00 INR/ha) and benefit cost ratio (2.20) was also recorded in treatment 7 Kadiri Amaravathi + Spacing (30 cm x 15 cm) as compared to other treatments. It was concluded that in Groundnut variety with the combination of Kadiri Amaravathi and spacing of (30cmx15cm) in Treatment-7 was recorded highest seed yield and B: C ratio.

Keywords: Economics; growth; groundnut; spacing; varieties; yield.

1. INTRODUCTION

Groundnut (*Arachis hypogea* L.) is a legume crop commonly known as peanut/earthnut. It is a self-pollinated, annual, and herbaceous crop. The Groundnut contains 45% of oil and 26% protein in kernels. As being the King of Vegetable oilseeds in India, it occupies pre-eminent position in national edible oil economy. Groundnut is originated from Brazil. In India Groundnut cultivation is produces from 7.00 m.t productivity that is 1045 kg/ha from 6.64 m.ha area respectively (FAO Production Yearbook, (2004). In Uttar Pradesh, it is cultivated in an area of 8.51 mha and its production and productivity are 6.94 mt and 816kg/ha respectively. (Fertilizer Association of India, 2006). “Groundnut is a major oil seed crop that contains around 45% to 51% high-quality hydrogenated edible oil, dietary proteins (26%) as well as soluble carbohydrates (24.2%) and minerals. It is used not only as edible oil, but also used in manufacturing of hydrogenated vegetable oil, soaps, toilet requisites and for culinary purpose at well. Groundnut also high in vitamins such as A, B_1, B_2, and E and the cake is rich in protein content (46%), hence make it good for poultry and animal feed” [1].

“Variety is the most important factor in groundnut production. Use of high yielding varieties has been increased remarkably in recent years and the country has reached almost a level of sufficiency in Groundnut. Optimum plant population with unit area per hectare for a given variety at specific situation not only reduce the cost of cultivation but also augment to the full yield potential of the cultivar (Dileep et al., 2021). kadiri-6 varieties’ crop duration is 100-105 DAS in *kharif* 110-115 DAS in *rabi*. Its average yield in is 20-25 q/ha in *kharif* and 40-45 q/ha in *rabi*. The Oil percentage is 48% and shelling is 74%. The kadiri-6 is an early maturing variety, high yielding, spanish bunch, attractive kernel and synchronous maturity” (Salma et al., 2023). “TAG-24 is the high yielding, Spanish bunchy type variety of Ground nut. This variety is of 100-105days duration which gives pod yield of 1311 kg/ha, oil percentage of 45.5%This variety is tolerant to bud necrosis and jassids. In Kadiri Amaravathi, the crop duration is 115-120 DAS in *kharif* while 120-125 DAS in *rabi*. Its average yield in is 20-25 q/ha (kharif) and 40-45 q/ha in *rabi*. The oil percentage is 50% and shelling is 70%. Kadiri Amaravathi is high yielding, medium duration, Spanish bunch with attractive pods like kadiri-6. It is also Resistant to sucking pests like thrips, hoppers, mite, and life eating insects, Spodoptera and Helicoverpa” (P.P. Reddy et al., 2023).

“The cost-effective technologies for utilization of natural resources such as optimum row spacing, precise nutrient and irrigation management, timely weed management etc, are the important agronomic techniques for enhancing and stabilizing the yield of any crop. The plant density is one of the important factors which play a vital role in enhancing the production and productivity of Groundnut. 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” [2]. “If early weeding is done properly and recommended crop spacing is followed, then the weeds that come up later are smothered due to the vigorous growth of the crop. Plant density is an efficient management tool for maximizing grain yield thought enhancement in in the of solar radiation capture by the canopy, thereby increasing land use efficiency. The plant population is often determined by the various attributes that are largely under grower control and one of the major aspects of crop ecology, production and management which often limits crop production, improper crop density” [3]. In order to increase the yield and to gain more profits we need to adopt cultivation of certain developed varieties. We adopt specified plant geometry for growing crops so that plant can grow freely without any competition and will give more yield by utilizing the resources provided. So to know which variety exhibits better growth parameters and higher yield at different plant geometry in Prayagraj conditions a field trail on ‘Response of summer Groundnut varieties as influenced by plant geometry on growth and yield of Groundnut (*Arachis hypogea* L.)

2. MATERIALS AND METHODS

The experiment was carried out at the Crop Research Farm, Department of Agronomy, SHUATS Prayagraj, (U.P) during *Zaid* season of 2023. The soil of the experimental field constituting a part of central Gangetic alluvial which is deep and neutral (PH 7.2). The soil was sandy loam in texture with high in organic carbon (0.941%) and low in available nitrogen (225kg/ha), high in phosphorous(43.5kg/ha) and medium in potassium(253.4kg/ha). The treatments consist of three different varieties viz., Kadiri-6, TAG-24, Kadiri Amaravati with the combination of different row spacing of 30 cmx15 cm, 35 cmx15 cm, 45 cmx10 cm. The experiment was laid out in Randomized Block Design (RBD) with total 27 plots and size of each plot was 9 m^2 with 9 treatments each replicated thrice. The treatment combinations are T_1 [(Kadiri -6 + Spacing (30 cm x 15cm)] ,T_2 [(Kadiri-6 + Spacing (35 cm × 15 cm)] ,T_3 [(Kadiri-6 + Spacing (45cm×10cm)],T_4 [(TAG-24+spacing (30cmx 15cm)], T_5 [(TAG-24+spacin(35cmx15cm)], T_6 [TAG-24+spacing (45cmx10cm)], T_7 [(Kadiri Amaravati + Spacing (30 cm x 15cm)], T_8 [(Kadiri Amaravati + Spacing (35 cm x 15cm)],T_9 [(Kadiri Amaravati + Spacing (45 cm x 10cm)].Urea, SSP, and MOP were chosen as the source for N, P, and K 20,40,50 kg/ha respectively. The growth parameters such as, plant height (cm), dry weight (g), no/nodules (No), Crop Growth Rate (g/ m^2/day), Relative Growth Gate (g/g/day), and yield attributes that no. of pods /plant, no.of kernels/pod, seed Index (g), kernal yield (t/ha), halum yield (t/ha)harvest Index (%), shelling (%). The parameters were calculated and analysed using the statistical tool Analysis of Variance (ANOVA) for randomized block desingn [4].

3. RESULTS AND DISCUSSION

A. Growth Parameters

1. Plant height (cm)

The significantly highest plant height(37.78cm) was observed in treatment-7 that is Kadiri Amaravathi variety with the spacing 30cm x 15 cm, However, treatment 8[(Kadiri Amaravathi + Spacing (35 cm x 15 cm)] (35.66) and treatment 1[(Kadiri - 6 +Spacing 30cm x 15 cm] (35.80) were found statistically at par with treatment 7 .It might be due to wider space between plants in a row gave the opportunity for all the resources to be available readily to the individual plants such as nutrients, light, space, moisture thus, resulting in higher growth rate of the plant. Similar, results were also reported by Ngala et al. [5] as, Kadiri Amaravathi has fast growing and bushy habit. Further, the differential behavior among the varieties depends on their genetic makeup and prevailing weather conditions [6].

2. Number of nodules/plants

Significantly highest number of nodules/plants (125.77) were observed in Kadiri Amaravathi variety with the spacing of 30 cm x 15 cm However, treatment 8 [(Kadiri Amaravathi + Spacing (35 cm x 15 cm)] was found statistically at par (49.89) with highest treatment. This is genetic makeup of the plants, or it has capability to respond better under optimum resource available. Similar observations have been reported by Soomrao and Khan [7]. The more no.of nodules/plant was recorded in spacing (30cmx15cm) which might due to better growth of plant because of optimum growth resources available to individual plant and their maximum utilization throughout the growth periods as per requirement of the crop.These results were corroborated by Birendra et al. (2017).

3. Plant dry weight (g/plant)

Significantly and highest plant dry weight (22.37) was observed in the treatment 7 that is Kadiri Amaravathi with the spacing (30cm x 15 cm) .However, treatment 6 [(TAG -24+ Spacing (45 cm x 10 cm)] and treatment 1 [(Kadiri -6 + Spacing 30 cm × 15cm] were found statistically at par (20.78g,20.78g) with treatment 7.This might be due to the production increased steadily with advancing growth stages and reached the maximum at harvest results in highest dry weight of the plant. Similar results were also reported by Varshitha [8]. Highest dry weight was observed in Kadiri Amaravathi, might be due to production of greater number of branches per plant and increased assimilation of nutrients which increased the leaf biomass compared to other varieties [9].

B. Yield Attributes

1. Number of Pods/plants

The significantly highest number of pods/plant (30.20) was recorded in treatment 7 [Kadiri Amaravathi + Spacing (30 cm x 15 cm)]. However, treatment 2[Kadiri-6 + Spacing 35 cm × 15 cm)], treatment 1[Kadiri - 6 +Spacing 30cm x 15 cm)] and treatment 8[Kadiri Amaravathi +Spacing 30cm x 15 cm)] were found to

be statistically at par (27.73,28.06,28.26) respectively with treatment 7 [Kadiri Amaravathi + Spacing (30 cm x 15cm)].This result due to the sufficient space between each rows which encouraged more plant growth and also less in inter competition for space, light, nutrient and moisture. Similar, results were reported by Chandrasekaran [10]. Highest pods/plant was observed in the variety Kadiri Amaravathi due to the variation in the number of pods per plant observed was highly attributed to the genetic character of the Groundnut varieties. Similar results were reported by Gabisa et al. [11].

2. Number of kernels/pods

Significantly and highest number of kernels/pod (1.50) was recorded in the treatment 7 [Kadiri Amaravathi + Spacing (30 cm x 15 cm)]. However, the treatment 8 [Kadiri Amaravathi + Spacing (30cm x 15 cm)] and treatment 1[Kadiri -6 +Spacing 30cm x 15 cm)] were statistically at par (1.38,1.42) with treatment 7. This might be due to wider spacing plants have more space to grow vigorously and produced very lengthy pods, which contained more seeds. Similar results were also agreed by Shaukat et al. [12] and Idris et al. [13].

3. Seed Index (g)

The significantly highest seed index (33.20 g) was recorded in treatment 7 [Kadiri Amaravathi + Spacing (30 cm x 15 cm)]. However, treatment 2[Kadiri-6 + Spacing 35 cm × 15 cm)].and treatment 9 [Kadiri Amaravathi + Spacing 45 cm x 10 cm)]. were found to be statistically at par (30.46,30.46) with the treatment 7. The maximum seed index was observed with spacing 30 cm x 15 cm. This might be due to wider spacing that provides more soil space for growth and development due to less plant competition both in above and below the ground biomass resulting better proliferation and higher canopy development, hence resulting in higher nutrients uptake, seed fillings and more seed weight. Similar results were reported by Singh et al. [14].

4. Kernal yield (t/ha)

The significantly highest seed yield (2.91 t/ha) was recorded in treatment 7 [Kadiri Amaravathi + Spacing (30 cm x 15 cm)]. However, treatment 1 [Kadiri Amaravathi + Spacing 45 cm x 10 cm)], was found to be statistically at par (2.50) with treatment 7. This might be due to the better availability of growth resources like water, nutrients, air, better intercultural practices and effective weed control in wider plant geometry were aided the plants to exhibit their maximum yield full potential and produced higher yield. Similar findings were also agreed by Meena et al. [15].

5. Haulm yield (t/ha)

Highest haulm yield (5.20 t/ha) was recorded in treatment 7 [Kadiri Amaravathi+ Spacing (30 cm x 15 cm)]. However, treatment 8[Kadiri Amaravathi + Spacing 35 cm x 15 cm)], was statistically at par (4.93) with treatment 7. This might be due to optimum row spacing that have effectively utilized the growth resources, particularly solar radiation. Similar results were reported by Bhairappavar et al. [16] and Murade et al. [17]. The highest haulm yield was obtained with Kadiri Amaravathi, rest of the varieties tried, due to increased vegetative growth in terms of plant height, Leaf Area Index and dry matter production resulting in increased haulm yield [18].

6. Harvest Index (%)

The significantly highest harvest index (35.86%) was recorded in treatment 7 [Kadiri Amaravathi +Spacing (30 cm × 15 cm)]. However, treatment 4 [TAG-24 + Spacing 30 cm x 15 cm)], [19,20] was found to be statistically at par (33.59) with the highest treatment 7.

7. Shelling Percentage (%)

Significantly highest Shelling Percentage (55.97%) was recorded in treatment 7 [Kadiri Amaravathi +Spacing (30cm×15cm. However, treatment 4 [TAG-24 + Spacing 30 cm 15 cm)], was found to be statistically at par (50.59) with treatment 7. Significantly highest shelling percentage (55.97%) was recorded with Kadiri Amaravathi variety [21]. The reason is that the difference between the varieties for the shelling percentage originated from their genetic background. Similar results were reported by Rakesh et al. [22].

C. Economics

The maximum gross return (141650.00 INR/ha), net return (97386.00 INR/ha) and highest benefit cost ratio (2.20) was recorded in treatment-7 Kadiri Amaravathi + Spacing (30 cm × 15 cm). Which might be due to the varieties and spacing was found to be best confectionery Groundnut for getting higher yield and returns [23-25].

Table 1. Influence of plant geometry on growth attributes of summer groundnut varieties

		At 80 DAS		At 60 DAS	At 40-60 DAS	
S.No.	**Treatments combinations**	**Plant Height (cm)**	**PlantDry weight (g)**	**No. of Nodules/plant**	**CGR (g/m^2/day)**	**RGR (g/g/day)**
1	Kadiri - 6 +Spacing 30cm x 15 cm	35.80	20.78	114.66	6.47	0.023
2.	Kadiri-6 + Spacing 35 cm × 15 cm	34.28	18.26	111.00	4.33	0.022
3.	Kadiri -6 + Spacing 45 cm × 10cm	36.10	18.41	112.88	5.92	0.023
4.	TAG-24 + Spacing 30 cm x 15 cm	34.67	21.43	112.33	4.27	0.016
5.	TAG-24 + Spacing 35 cm x 15 cm	34.08	19.46	115.00	6.06	0.026
6.	TAG-24 + Spacing 45 cm x 10 cm	33.48	20.35	108.55	7.02	0.027
7.	Kadiri Amaravathi+ Spacing 30 cm x 15cm	37.78	22.37	125.77	7.06	0.024
8.	Kadiri Amaravathi + Spacing 35 cm x 15cm	35.66	19.5	120.44	4.97	0.022
9.	Kadiri Amaravahti + Spacing 45 cm x 10 cm	34.44	21.46	115.44	7.27	0.026
	SEm(±)	0.78	0.72	3.01	0.65	0.0025
	CD (P=0.05)	2.36	2.18	9.05	1.95	-

Table 2. Influence of plant geometry on yield and yield attributes of summer groundnut varieties

Treatment combinations	**Pods/ plant**	**Kernels/pods**	**Seed Index (g)**	**Seed yield (t/ha)**	**Halum Yield (t/ha)**	**Harvest index (%)**	**Shelling (%)**
1. Kadiri - 6 +Spacing 30 cmx 15 cm	28.06	1.42	29.10	2.50	5.16	32.40	48.18
2. Kadiri-6 + Spacing 35 cm × 15 cm	27.73	1.25	30.46	2.05	4.43	31.76	46.77
3. Kadiri -6 + Spacing 45 cm × 10cm	26.80	1.20	28.70	2.10	4.30	32.84	48.93
4. TAG-24 + Spacing 30 cm x 15 cm	27.00	1.30	31.07	2.21	4.36	33.59	50.59
5. TAG-24 + Spacing 35 cm x 15 cm	26.46	1.25	30.36	2.03	4.43	31.44	45.93
6. TAG-24 + Spacing 45 cm x 10 cm	24.33	1.26	30.43	2.17	4.53	32.38	47.90
7. Kadiri Amaravathi+ Spacing 30 cm x 15 cm	30.20	1.50	32.20	2.91	5.20	35.86	55.97
8. Kadiri Amaravathi + Spacing 35 cm x 15 cm	28.26	1.38	30.27	2.36	4.93	32.44	48.05
9. Kadiri Amaravathi + Spacing 45 cm x 10 cm	26.80	1.32	30.46	2.46	4.43	35.75	55.66
SEm±	0.97	0.050	0.622	0.141	0.186	0.99	2.15
CD (p = 0.05)	2.91	0.150	1.865	0.422	0.560	2.97	6.46

Table 3. Influence of plant geometry on economics of summer groundnut varieties

S.No	Treatment combinations	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C
1.	Kadiri - 6 +Spacing 30cm x 15 cm	44264.00	122833.33	78569.33	1.78
2.	Kadiri-6 + Spacing 35 cm × 15 cm	43164.00	101116.67	57952.67	1.34
3.	Kadiri -6 + Spacing 45 cm × 10cm	44264.00	103100.00	58836.00	1.33
4.	TAG-24 + Spacing 30 cm x 15 cm	44264.00	108183.33	63919.33	1.44
5.	TAG-24 + Spacing 35 cm x 15 cm	43164.00	100366.67	57202.67	1.33
6.	TAG-24 + Spacing 45 cm x 10 cm	44264.00	106866.67	62602.67	1.41
7.	Kadiri Amaravathi+ Spacing 30 cm x 15cm	44264.00	141650.00	97386.00	2.20
8.	Kadiri Amaravathi + Spacing 35 cm x 15cm	43164.00	116366.67	73202.67	1.70
9.	Kadiri Amaravathi + Spacing 45 cm x 10 cm	44264.00	119866.67	75602.67	1.71

4. CONCLUSION

In the treatment investigation among all three Groundnut Varieties, Kadiri Amaravathi produced more yield with spacing 30cmx15cm as well as economics also.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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