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Crop growth indices of groundnut (*Arachis hypogaea* L.) affected by varied planting dates

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ABSTRACT

The objective of this study was to assess the influence of different planting dates on the growth of groundnut (*Arachis hypogaea* L.). The experiment utilized a randomized block design, employing four planting dates (November 1st, November 15th, December 1st, and December 15th) with five replications at Instructional Farm Vellanikkara, Kerala Agricultural University, during 2019–2020. The chosen variety for the study was TNAU CO-6. Continuous monitoring of crop development data was conducted in the experimental plot. An analysis of variance was performed to evaluate the impact of planting dates on various crop growth indicators, including plant height, leaf number, dry matter accumulation, and leaf area index. Overall, the results demonstrated a significant influence of planting dates on these key parameters. Notably, the November 1st planting consistently exhibited significantly higher values compared to other dates, emphasizing the pivotal role of selecting an optimal planting date. November 1st, in particular, emerged as highly favorable for achieving superior crop growth

Keywords: Planting dates, TNAU CO-6, Plant height, Leaf number, Dry matter accumulation and Leaf area index

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INTRODUCTION

Groundnut, also referred to as peanut (*Arachis hypogaea* L.), is one of the most important oil seed crops in the world. It is grown around the world in warm temperate, subtropical, and tropical temperature zones (Sogut *et al.*, 2016). It is the third-most significant source of vegetable protein and a notable source of edible oil. Groundnut is essentially a tropical plant, and it requires a long and warm growing season. The crop maintains soil fertility by fixing atmospheric nitrogen. The extent of the influence of weather on crop growth mainly depends on its growth stages; hence, the impacts of climate on crops affect them differently at different stages of their development. It can be characterized as an economically significant crop. The stalks play a vital role as valuable fodder for ruminant livestock, particularly sheep and goats (Li *et al.*, 2013). Furthermore, the plant, by virtue of its biological activities in nitrogen fixation, assumes a pivotal role as a soil fertility-conserving agent (Mofya-Mukuka and Shipekesa, 2013). In India, areas of the peninsular region, as well as the western and central zones, have low to moderate rainfall levels, and the groundnut season lasts just 90 to 120 days. The most suitable climatic conditions for groundnuts are long and warm growth seasons with a well-distributed rainfall of at least 500 mm, a profusion of sunshine, and a moderately warm temperature throughout the growing season. If the anticipated demand for oils and fats is to be met while maintaining sustainability, groundnut will continue to be a significant oil seed crop for the semi-arid regions. There is a high level of fluctuation in production depending on the rainfall. One of the main micro-climatic elements influencing growth rates is temperature. The temperature around a plant affects how quickly it grows and develops, and each species has a specified temperature range that is represented by a minimum, maximum, and optimal.

Location, sowing date, and temperature are the three main factors that determine how long it takes cultivars to mature. The number of days from planting to physiological maturity varies from year to year and from location to location, which makes it difficult to anticipate how a crop will develop (Baskaran *et al.*, 2020). Sowing at the right time is one of the important management variables for maximizing yield (Hatfield *et al.*, 2011).

Beyond the type planted, the best timing depends primarily on the local agro-climatic circumstances. The optimal timing for groundnut sowing is contingent upon the specific variety and prevailing growing conditions, taking into account the diverse agro-climatic zones and agro-ecological factors. Therefore, precise adjustments to the sowing date play a crucial role in maximizing the climatic conditions favorable for the growth and yield of the groundnut crop, as highlighted by Kumar *et al.* (2020). Hence, the present study was undertaken to find out the optimum sowing time to get the best growth of groundnut.

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Table 1: Effect of dates of planting on plant height at weekly intervals

Dates of planting	Week number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
D1	6.55a	9.31a	13.44a	13.98a	15.37a	16.56a	17.45a	18.28a	18.72a	19.19a	19.53a	19.82a	20.11a	20.33a	20.44a	20.45a
D2	5.56b	8.67b	11.32b	13.64a	13.39b	14.43b	15.12b	15.64b	16.10b	16.52b	16.86b	17.18b	17.48 b	17.73b	17.91b	17.96b
D3	5.40bc	7.43c	9.01c	10.95b	12.53b	13.29b	14.13b	14.82b	15.46b	16.07b	16.58b	17.08b	17.53 b	17.87b	18.08b	18.11b
D4	4.82c	6.88c	8.39c	9.59b	10.64c	11.44c	12.23c	12.87c	13.53c	14.09c	14.63c	15.10c	15.56c	15.81c	15.93c	15.94c
CD	0.60	0.61	2.03	2.27	1.38	1.49	1.51	1.60	1.55	1.54	1.54	1.54	1.59	1.59	1.60	1.60

D1 – November 1st , D2 – November 15th, D3 – December 1st, D4 – December 15th

Table 2: Effect of dates of planting on number of leaves at weekly intervals

Dates of planting	Week number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
D1	12.48^{b}	24.58^{a}	42.24^{a}	53.76^{a}	65.86^{a}	75.76^{a}	83.84^{a}	88.37^{a}	93.34^{a}	95.67^{a}	98.06^{a}	99.62^{a}	105.64^{a}	109.06^{a}	112.94^{a}	115.76^{a}
D2	15.1^{a}	25.28^{a}	36.32^{b}	45.86^{b}	56.00^{b}	64.17^{b}	73.13^{b}	80.50^{b}	87.03^{a}	93.83^{a}	99.13^{a}	102.83^{a}	105.31^{a}	104.74^{a}	103.10^{ab}	100.65^{ab}
D3	10.82^{bc}	20.85^{b}	35.25^{b}	52.21^{ab}	64.96^{a}	75.28^{a}	81.36^{a}	87.62^{a}	92.90^{a}	95.68^{a}	98.13^{a}	98.18^{a}	99.36^{a}	98.40^{a}	94.93^{b}	92.37^{b}
D4	9.29^{c}	17.45^{c}	25.69^{c}	35.60^{c}	42.61^{c}	48.10^{c}	52.42^{c}	56.93^{c}	61.04^{b}	65.88^{b}	68.62^{b}	70.70^{b}	71.18^{b}	70.84^{b}	70.13^{c}	68.66^{c}
CD	1.96	1.90	5.64	6.99	8.10	8.91	7.58	6.95	7.53	7.95	9.96	12.40	11.99	14.17	16.72	18.32

D1 – November 1st , D2 – November 15th, D3 – December 1st, D4 – December 15th

MATERIALS AND METHODS

The field experiment was conducted on ground nut at Instructional Farm, Vellanikkara, during the *rabi* season of 2019–20. The variety used for the study was TNAU CO-6, and the spacing adopted was 15 cm × 15 cm. The experimental design used in the study was a randomized block design. The treatments were four dates of planting with five replications. The four dates of planting used were November 1st, November 15th, December 1st, and December 15th. The recommended doses of fertilizers (10 N, 75 P2O5, 75 K2O kg ha^{-1}) were applied to the crop as basal. All the management practices were done according to the package of practices recommended by Anonymous (2016). The plant height and number of leaves were measured at a weekly interval, and dry matter accumulation and leaf area index were measured at fortnightly intervals. The analysis of variance and level of significance, along with the least significant difference (LSD) test, were done as follows: The R Studio software was used for the statistical analysis. (R Studio Team, 2020)

RESULTS AND DISCUSSION

Analysis of variance was carried out for plant height recorded at a weekly interval up to 120 days and is represented in Table 1. The effect of dates of planting on plant height was found to be significant. Plant height recorded during the November 1st planting was found to be higher compared to other dates of planting. During the fourth week, the plant height recorded during the November 1st planting (13.98 cm) was on par with the November 15th planting (13.64 cm). Plant height was found to decrease with delayed planting. Maximum plant height was recorded during the 16th week. The lowest plant height was recorded during the December 15th planting of all the weeks.

The effect of planting dates on the number of leaves at a weekly interval is given in Table 2. In the first week, the

Plate 1. 20 Days after planting

Table 3: Effect of dates of planting on dry matter accumulation at fortnightly intervals

Dates of planting	Days after planting (DAP)							
	15DAP	30DAP	45DAP	60DAP	75DAP	90DAP	105DAP	120DAP
D1	250.66	626.07^{a}	1995.84^{a}	2746.07^{a}	2170.66^{a}	2629.03^{a}	2675.55^{a}	3326.51^{a}
D2	207.99	375.40^{b}	1002.07^{b}	2088.59^{b}	1980.73^{a}	2263.70^{b}	2497.47^{a}	2712.88^{b}
D3	212.44	436.44^{b}	746.66^{b}	1300.44^{c}	1904.29^{a}	2028.14^{b}	2076.14^{b}	2705.47^{b}
D4	221.62	417.18^{b}	641.48^{b}	832.88^{c}	1418.66^{b}	1209.48^{c}	1934.51^{b}	1873.18^{c}
CD	**NS**	**153.53**	**396.97**	**522.41**	**353.91**	**355.89**	**290.29**	**537.90**

D1 – November 1st , D2 – November 15th, D3 – December 1st, D4 – December 15th

Table 4: Effect of dates of planting on Leaf area index at fortnightly intervals

Dates of planting	Days after planting (DAP)							
	15DAP	30DAP	45DAP	60DAP	75DAP	90DAP	105 DAP	120DAP
D1	0.22^{a}	0.61^{a}	0.87^{a}	1.13^{ab}	1.34	1.57	1.75	1.81
D2	0.18^{a}	0.50^{ab}	0.82^{a}	1.22^{a}	1.34	1.59	1.70	1.71
D3	0.14^{b}	0.48^{b}	0.88^{a}	1.30^{a}	1.51	1.63	1.77	1.71
D4	0.12^{b}	0.42^{b}	0.62^{b}	0.92^{b}	1.33	1.66	1.83	1.80
CD	0.04	0.011	0.019	0.24	NS			

D1 – November 1st , D2 – November 15th, D3 – December 1st, D4 – December 15th

number of leaves recorded during the November 15th planting was higher (15.1), and the number of leaves recorded during the December 15th planting was lower (9.29). In the second week, the number of leaves recorded during the November 1st and November 15th plantings was on par. For the third week, the maximum (42.24) number of leaves was recorded during the November 1st planting, and the minimum number of leaves was recorded during the December 15th planting (25.69). The November 15th planting was on par with the December 1st planting during the 4th week. The number of leaves recorded during the December 1st planting was on par with the November 1st planting in all the weeks except the 1st, 2nd, 3rd, 15th, and 16th weeks. The number of leaves recorded during the December 15th planting was found to be lower in all the weeks.

Plate 2. Liming and earthing up

The effect of dates of planting on dry matter accumulation at a fortnightly interval is given in Table 3. Dry matter accumulation at a fortnightly interval was found to be significantly influenced by dates of planting. The result indicates that dry matter accumulation on November 1st was higher during 30, 45, 60, 90, and 120 DAP. Dry matter accumulation recorded during November 1st planting (2675.55 kg ha^{-1}) was on par with November 15th (2497.47 kg ha^{-1}) 105 DAP. Dry matter accumulation was found to decrease with the delayed planting. The results showed that the crop growth rate (CGR) of groundnut was significantly affected by planting dates. The study found that the highest CGR was obtained from the early planting date (first week of June), while the lowest CGR was obtained from the late planting date. Another study conducted in Nigeria reported that delayed planting resulted in a significant reduction in the CGR of groundnut. The study found that groundnut planted in the first week of July had the highest CGR, while the lowest CGR was recorded for the crop planted in the third week of

Plate 3. experimental farm

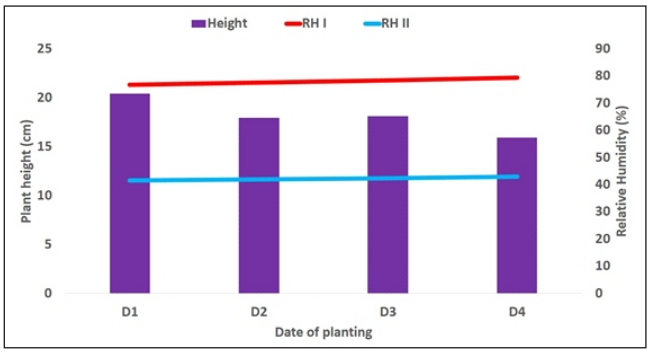

Fig. 1: Influence of forenoon and after noon relative humidity on plant height

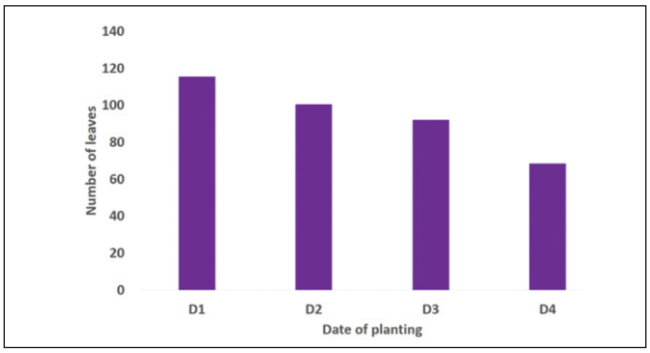

Fig. 2 : Number of leaves per plant recorded under different dates of planting

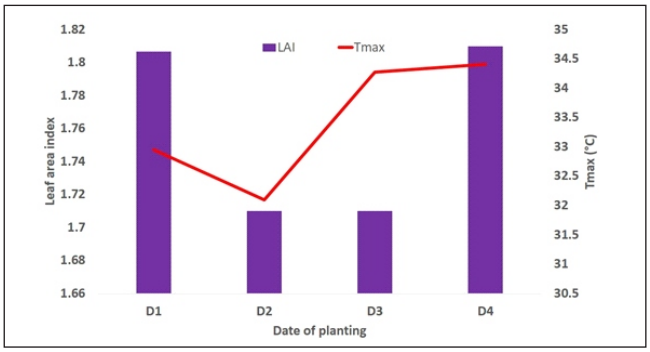

Fig. 3: Effect of maximum temperature on leaf area index

August (Okoruwa *et al.*, 2014).

The effect of dates of planting on leaf area index at a fortnightly interval was found to be statistically significant at 15, 30, 45, and 60 days after planting. Table 4 represents the effect of planting dates on leaf area index at a fortnightly interval. The result showed that the highest value of leaf area index at 15 days after planting was observed on November 1st. Leaf area index recorded during November 1st planting (0.22) was on par with November 15th planting (0.18) and leaf area index recorded during December 1st planting (0.14) was on par with December 15th planting (0.12) at 15 days after planting. At 30 days after planting, the leaf area index recorded at a fortnightly interval during November 1st planting (0.61) was on par with November 15th planting (0.50), and that recorded during November 15th planting was on par with December 1st (0.48) and December 15th (0.42) planting. 45 days after planting, the leaf area index recorded for a fortnightly interval during November 1st planting (0.87) was on par with November 15th planting (0.82) and December 1st planting (0.88).

Plant height, number of leaves, and the leaf area index were all shown to be significantly higher under D1 (November 1st) planting and to be declining with delay in planting. High relative humidity in the morning and evening would drastically lower the plant height; relative humidity was lower for D1 planting than the other three plantings in the morning and afternoon, and it rose as planting time increased (Fig. 1). This tendency in relative humidity caused plant height to increase during D1 and decrease with a delay in planting. The maximum number of leaves was observed for November 1st (D1) planting, which was superior over D3 (December 1st), D2 (November 15th), and D4 (December 15th) planting, i.e., with delay in planting, the number of leaves decreased (Fig. 2). Similar results were given by Giridhar (2019). According to Giridhar, the maximum number of functional leaves was recorded at the earlier date of planting. An increased number of leaves was associated with increased shoot length.

The maximum leaf area index was observed for November 1st planting, and the value of LAI decreased with a delay in planting. Hardwick *et al.* (2014) found that maximum air temperature showed a significant negative correlation with LAI. The maximum temperature experienced during the vegetative stage was less under early planting, i.e., D1 and D2, and increased with delay in planting. The effect of this maximum air temperature might have reduced the leaf area index with a delay in planting (Fig. 3).

CONCLUSION

The effects of dates of planting on plant growth were found to be significant. Varying planting dates offer varying weather circumstances, and the one that delivers optimal weather conditions is thought to be the best planting date since it promotes better growth. The optimal planting date for crop growth among the four dates of planting was determined to be November 1st. Under November 1st planting, it was found that the maximum plant height, total number of leaves, and leaf area index were all much higher. The maximum temperature on November 1st and the low relative humidity may have facilitated better crop growth. Choosing the right planting date for the crop's growth is important for getting the best crop yield and minimizing risk.

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