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Effect of sowing dates in groundnut (*Arachis hypogea* L.) on growth, yield attributing characters and yield

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ABSTRACT : Groundnut (*Arachis Hypogea* L.) is an annual legume which is also known as earthnut, monkey nut, peanut and goober nut. It is the 13th most important food crop and 4th most important oilseed crop of the World. The experiment was laid out in Randomized Block Design with five sowing dates *viz.*, S_1 -22nd June, S_2 -29th June, S_3 -6th July, S_4 -13th July and S_5 - 20th July and four replications. The soil of the experimental plot was leveled and medium deep with good drainage and was suitable for growth of the groundnut crop. The crop growth observations *viz.*, plant height, number of branches, number of leaves and leaf area plant^{-1} were recorded periodically at an interval of 15 days *i.e.*, 30, 45, 60, 75, 90, 105 DAS and at harvest. The observations on days to 50 per cent flowering, days to pod initiation, days to 50 per cent pod maturity were recorded at the respective time. The observations on days to harvesting, number of mature pods plant^{-1}, wet and dry pod weight plot^{-1} and ha^{-1} were recorded at the time of harvest and after the harvest of the crop. The results indicated that the treatment sowing date *viz.*, 6th July significantly influenced various growth contributing characters like plant height (39.99 cm), number of branches plant^{-1} (8.13), number of branches (8.13), leaf area (dm^2) plant^{-1} (28.97), days to 50 per cent flowering (28.94), days to pod initiation (59.00), as well as yield contributing characters and yield *viz.*, days to 50 per cent maturity (91.25), days to harvesting (109), number of mature pods plant^{-1} (23.88), green pod weight kg plot^{-1} (4.23), green pod weight q ha^{-1} (36.83) and the dry pod weight kg plot^{-1} (3.15), dry pod weight q ha^{-1} (32.83) and was found significantly superior over all the sowing date treatments *viz.*, S_5, S_4, S_2 and S_1.

KEY **W**ORDS : Groundnut, Sowing dates, Growth, Yield

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Groundnut is the largest source of edible oil in India and constitutes roughly about 50 per cent of the total oilseeds production. Among oilseeds crops in India, groundnut accounts for about 50 per cent of area and 45 per cent of oil production**.** In India, about 75 per cent of the groundnut area lies in a low to moderate rainfall zone (parts of peninsular region and western and central regions) with a short period of rainfall distribution. In India, most of the groundnut production is concentrated in five states *viz.*, Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra.

RESEARCH PROCEDURE

A replicated field experiment was conducted on a

Table A : The periodic biometric observations were recorded as details below

Sr. No.	Observation	Freq.	DAS	Sample
Plant count				
1.	Initial plant count	1	20	Net plot
2.	Final plant count	1	At harvest	Net plot
Growth characters				
1.	Plant height, no. of branches (cm), leaf area (dm^2)	7	30,45,60,75,90,105,Har	5 plants
2.	Days to 50 % flowering, days to pod initiation, days to 50% maturity, days to harvesting	1	Varying as per treatment	Net plot
Yield contributing characters				
1.	No. of mature pods $plant^{-1}$, yield $plot^{-1}$ and ha^{-1}, Green pod weight $plot^{-1}$ and ha^{-1}, dry pod weight $plot^{-1}$ and ha^{-1}	1	At harvest	Net plot

plot using groundnut (variety JL-24) during the *Kharif* at the Department of Agricultural Meteorology Farm, College of Agriculture, Pune. The sowing of groundnut was done with spacing 30 cm × 10 cm as per different five sowing dates. The soil of the experimental field was medium deep with adequate fertility and was suitable for a growth of the groundnut crop in Randomized Block Design (RBD). The groundnut crop was harvested when the colour of inner side of shell turned grayish. The maturity of pods was ensured by uprooting the border plants.

The tabulated data were statistically processed by the standard method of analysis of variance for the Randomized Block Design and test of significance as given by Panse and Sukhatme (1985).

RESEARCH ANALYSIS AND REASONING

The present investigation results obtained are presented here under.

Plant count :

The data pertaining to plant count of groundnut as affected periodically by different treatments are presented and discussed in this paper.

Initial and final plant count :

The data in Table 1 in respect to initial and final plant count were not influenced due to any of the sowing date. However, the maximum initial and final plant count was observed in the S_3 treatment (6^{th} July) that is 3.32 lakh ha^{-1} and 3.23 lakh ha^{-1}, respectively. It was minimum 3.31 lakh ha^{-1} and 3.14 lakh ha^{-1} initial and final plant count in treatment S_5 (20^{th} July). However, the differences in the initial and final plant count were observed to be non-significant.

Growth characters :

The biometric observations of groundnut were recorded on various growth parameters *viz.*, plant height, number of leaves $plant^{-1}$, number of branches $plant^{-1}$ and leaf area (dm^2) at 15 days interval with effect from 30 DAS upto 105 DAS and at harvest and days to 50 per cent flowering, days to pod initiation, days to 50 per cent maturity and days to harvesting were recorded at the time of their occurrence.

Table 1 : Initial plant count at 20 DAS and final plant count at harvest influenced by different sowing dates in groundnut

Sr. No.	Treatments	Initial plant count $lakh^{-ha}$	Per cent count	Final plant count lakh-ha	Per cent count
1.	S_1 (22^{nd} June)	3.32	99.69	3.20	96.21
2.	S_2 (29^{th} June)	3.31	99.39	3.17	95.29
3.	S_3 (6^{th} July)	3.32	99.69	3.23	97.19
4.	S_4 (13^{th} July)	3.31	99.39	3.16	95.19
5.	S_5 (20^{th} July)	3.31	99.39	3.14	94.49
	S. E. ±	0.003		0.009	
	C.D. (P=0.05)	NS		NS	
	General mean	3.31		3.16	

NS=Non-significant

Plant height :

The data pertaining to mean plant height of groundnut as influenced by different sowing dates at different growth stages are presented in Table 2.

The mean plant height was increased with advancement of the crop age and maximum plant height was recorded at maturity (35.03 cm). The plant height was increased very fast between 30 to 45 DAS which may be due to active vegetative growth phase of the plant and at slow rate beyond 75 DAS as the plant enter from vegetative phase to reproductive phase.

The mean plant height was significantly influenced by different sowing dates at all observation intervals. The significantly higher plant height was recorded with sowing of groundnut during 6th July (S_3) at 30, 45, 60, 75, 90, 105 DAS and at harvest. This was followed by treatment S_2 that is sowing during 29th June, were statistically higher plant height was registered than S_5 (20th July), however it was at par with S_1 that is sowing during 22nd June being at par with S_4 (13th July) registered significantly higher plant height than S_5 treatment, that is sowing during (20th July). Whereas treatment S_5 (20th July) recorded statistically lowest plant height at all the stages of observations. It can be concluded that plant height in the treatment of sowing date of 6thJuly (S_3) was significantly superior as compared to other treatments during the crop growth period. It might be due to suitable weather conditions of different weather parameters during crop growing period. These results are similar to those reported by Gosh and Das Gupta (1975).

Number of branches plant^{-1} :

The data in respect to number of branches plant^{-1} of groundnut as affected by different dates of sowing treatments are presented in Table 3. The mean numbers of branches plant^{-1} were increased with advancement of the age of the crop and maximum number of branches was recorded at 90 DAS (7.07). The mean number of branches plant^{-1} were significantly influenced by different sowing dates at all observation intervals. The significantly higher number of branches plant^{-1} were recorded with sowing of groundnut during 6th July (S_3) at 30, 45, 60, 75, 90, 105 DAS and at harvest than rest of the sowing dates.

This was closely followed by treatment S_1 that is sowing during 22nd June and was statistically higher number of branches plant^{-1} was registered than S_5 (20th July). However, it was found to be at par with S_2 (29thJune) and S_4 (13thJuly) at all growth stages of the crop. The next best treatment was S_2 that is sowing during 29th June being at par with the treatment S_4 (13thJuly)

Table 2 : Plant height of groundnut as influenced by different sowing dates

Sr. No.	Treatments	Plant height (cm)						
		30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest
1.	S_1 (22nd June)	4.85	13.46	17.29	21.49	28.60	34.66	36.10
2.	S_2 (29th June)	4.87	13.49	17.15	21.48	27.78	34.44	35.11
3.	S_3 (6th July)	5.68	15.95	18.40	23.18	30.61	39.30	39.99
4.	S_4 (13th July)	4.38	13.44	16.34	21.39	27.53	32.35	34.48
5.	S_5 (20th July)	3.58	12.12	14.29	17.40	23.46	29.49	29.49
	S.E. ±	0.22	0.42	0.35	0.49	0.62	0.78	0.71
	C.D. (P=0.05)	0.70	1.32	1.08	1.53	1.92	2.43	2.20
	General mean	4.67	13.70	16.89	20.84	27.59	34.05	35.03

Table 3 : Number of branches of groundnut by different sowing dates

Sr. No.	Treatments	No. of branches plant^{-1}						
		30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest
1.	S_1 (22nd June)	3.81	4.76	5.79	6.05	7.31	7.31	7.31
2.	S_2 (29th June)	3.76	4.71	5.62	6.02	7.26	7.26	7.26
3.	S_3 (6th July)	4.73	5.49	6.56	7.04	8.13	8.13	8.13
4.	S_4 (13th July)	3.68	4.69	5.46	5.91	6.75	6.75	6.75
5.	S_5 (20th July)	2.39	4.25	4.28	4.99	5.90	5.90	5.90
	S.E. ±	0.29	0.14	0.25	0.28	0.24	0.24	0.24
	C.D. (P=0.05)	0.90	0.44	0.79	0.88	0.77	0.77	0.77
	General mean	3.67	4.77	5.55	6.00	7.07	7.07	7.07

recorded significantly higher number of branches than the treatment S_5, that is sowing during (20thJuly).

Among the number of branches plant^{-1} sown at S_5 treatment during 20th July registered significantly lower mean number of branches plant^{-1} at all the stages of observations. After 90 DAS upto the harvest the number of branches remained constant. From all the observations it can be concluded that the sowing date 6th July *i.e.*, treatment S_3 was significantly superior over all the other sowing date treatments. The similar results were recorded by Enikuomehin *et al.* (2002).

Leaf area (dm^2) plant^{-1} :

Results pertaining to the effect of different dates of sowing on leaf area (dm^2) plant^{-1} are presented in Table 4.

The mean leaf area dm^2 plant^{-1} increased progressively with the advancement in the crop age upto the 90 DAS during crop growing period and decreased from 90 DAS upto the harvest. The increase in leaf area plant^{-1} was rapid during flowering and reproductive period. The leaf area plant^{-1} increased very rapidly between 45-60 DAS which may be due to active vegetative phase and more number of leaves.

The mean leaf area plant^{-1} was influenced significantly by various sowing dates at 30, 45, 60, 75, 90,105 DAS and at harvest. The treatment (S_3) at 30, 45, 60, 75, 90, DAS recorded significantly higher leaf area with sowing of groundnut during 6thJuly than rest of the treatments. This was followed by treatment S_1 *i.e.*, sowing during 22nd June, noticed statistically higher values of leaf area plant^{-1} and statistically higher leaf area was registered than S_5 (20th July). However, it was at par with S_2 that is sowing during 29th June being at par with S_4 (13th July) at 30, 45, 60, 105 DAS and at harvest. However, at 75, 90, DAS it was significantly superior over rest of the treatments and found to be at par with treatment S_2 *i.e.*, sowing during 29thJune. This was closely followed by S_2 treatment that is sowing of groundnut during 29th June which recorded significant and highest leaf area than S_4 and S_5 treatments, where it was found at par with S_4 at 30, 45, 60, 75 and 90,105 DAS and at harvest. At 30, 45, 60, 75, 90, 105 DAS and at harvest the treatment S_4 (13th July) showed its significant superiority over the treatment S_5.

However sowing date (S_5) recorded significantly lower values of mean leaf area per plant at all observation periods. Leaf area (dm^2) plant^{-1} was reduced after 90 days because after 90 DAS the number of leaves was reduces by shedding of leaves due to senescence and disease incidence. Thus, it can be concluded that the treatment sowing date (S_3) 6th July was significantly

Table 4 : Leaf area (dm^2) plant^{-1} groundnut by different sowing dates

Sr. No.	Treatments	Leaf area per plant^{-1} (dm^2)						
		30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest
1.	S_1 (22nd June)	1.63	5.38	10.95	15.05	24.56	20.30	17.00
2.	S_2 (29th June)	1.60	5.29	10.54	14.45	23.05	20.01	15.64
3.	S_3 (6th July)	2.03	6.44	12.81	16.35	28.97	23.26	18.89
4.	S_4 (13th July)	1.51	5.22	10.43	13.80	21.67	19.42	15.19
5.	S_5 (20th July)	1.10	4.69	9.56	12.34	19.78	16.50	12.06
	S.E. ±	0.11	0.16	0.24	0.39	0.59	0.94	0.59
	C.D. (P=0.05)	0.35	0.51	0.76	1.22	1.84	2.89	1.82
	General mean	1.57	5.40	10.86	14.40	23.61	19.90	15.75

Table 5 : Days to 50% flowering, pod initiation, 50% maturity and days to harvesting of groundnut as influenced by sowing dates

Sr. No.	Treatments	Days to 50% flowering	Days to pod initiation	Days to 50% maturity	Days to harvesting
1.	S_1 (22nd June)	31.75	63.82	92.25	109
2.	S_2 (29th June)	33.00	64.00	94.75	110
3.	S_3 (6th July)	28.94	59.00	91.25	109
4.	S_4 (13th July)	34.38	64.06	95.50	113
5.	S_5 (20th July)	37.00	70.00	98.25	115
	S.E. ±	0.76	1.39	0.08	0.50
	C.D. (P=0.05)	2.34	4.31	0.26	1.56
	General mean	33.01	64.18	94.40	111.2

superior over all other remaining treatments.

The similar results were recorded by Gopalkrishnan *et al.* (1967) on the time of sowing of groundnut in *Kharif* season. They indicated July 7 as the optimum date of sowing and observed the highest net assimilation ratio and photosynthesis ratio at this sowing date.

Days to 50 per cent flowering :

The observation on days to 50 per cent flowering as influenced by different dates of sowing were recorded when groundnut plant put forth 50 per cent flowers. The data are presented in Table 5. The mean number of days to 50 per cent flowering significantly differed by various sowing date treatments. The sowing date (S_3) treatment that is sowing during 6thJuly recorded significantly lower mean number of days to 50 per cent flowering (28.94 days) than rest of the treatments. It was closely followed by treatment S_1 that is sowing during 22ndJune which was found at par with treatment S_2 that is sown during 29thJune. However, it was followed by 29th June (33.00) days registered significant over rest of the treatments and at par with the treatment S_4 (13thJuly). Whereas sowing date S_5 recorded significantly highest days (37.00) to 50 per cent flowering as compared to rest of the treatments. Thus, it can be concluded that the treatment S_3 *i.e.*, 6th July was significantly superior over all other remaining treatments. It might be due to maximum light interception during reproductive growth period of crop. The similar results were observed by Gopalkrishnan *et al*. (1967) at the time of sowing groundnut in *Kharif* season and indicated that the sowing groundnut in the second fortnight of June and first fortnight of July gave highest flower production. Later sowings reduced flower production, flowering duration and also were noticed that is maximum number of days required for flowering.

Days to pod initiation:

Results pertaining to the effect of different dates of sowing on days to pod initiation are presented in Table 5. The sowing date (S_3) treatment that is sowing during 6thJuly resulted significantly lower mean number of days to pod initiation (59.00) than rest of the treatments. It was closely followed by treatment S_1 that is sowing during 22ndJune which was found at par with treatment S_2 that is sown during 29thJune and treatment S_4 (13thJuly). However, it was followed by 29th June (S_3) and was significant over rest of the treatments and at par with the treatment S_4 (13thJuly).

The sowing date S_5, *i.e.*, sowing on 20thJuly recorded significantly highest days (70.00) to pod initiation as compared to rest of the treatments. Thus, it can be concluded that the treatment sowing date (S_3) 6th July (59.00) was significantly superior in relation to days to initiation of pods over all other remaining treatments, because there is positive correlation between days to flowering and days to pod initiation. Similar results were recorded by Gregory *et al*. (1951) and there was general agreement that a large number of early formed flowers developed into pods earlier.

Days to 50 per cent maturity :

It would observed from the data presented in Table 5 that the mean number of days to 50 per cent maturity differed significantly by different sowing date treatments. The number of days to 50 per cent maturity was minimum (91.25) in 6thJuly sowing date (S_3) and significantly lower than all other treatments. It was followed by treatment S_1 (22ndJune). The second best treatment was S_2 (sowing during 29thJune), which showed significant superiority over S_4 and S_5. Whereas, highest number of days to 50 per cent maturity (98.25) was recorded under S_5 during 20thJuly sowing.

Table 6 : Number of mature pods plant^{-1}, wet pod weight plot^{-1} in kg and ha^{-1} and dry pod weight plot^{-1} in kg and ha^{-1} of groundnut by different sowing dates

Sr. No.	Treatments	No. of mature pods plant^{-1}	Wet pod weight plot^{-1} (kg)	Wet pod weight ha^{-1}(q)	Dry pod weight plot^{-1} (kg)	Dry pod weight ha^{-1} (q)
1.	S_1 (22nd June)	18.55	3.38	31.96	2.41	24.56
2.	S_2 (29th June)	16.62	3.20	25.94	2.20	20.54
3.	S_3 (6th July)	23.88	4.23	36.83	3.15	32.83
4.	S_4 (13th July)	14.39	3.05	23.83	2.18	19.06
5.	S_5 (20th July)	12.46	2.33	21.86	1.65	16.11
	S.E. ±	0.45	0.21	0.61	0.11	0.65
	C.D. (P=0.05)	1.39	0.65	1.90	0.34	2.01
	General mean		3.24	28.08	2.32	22.62

Thus, it can be concluded that the S_3 treatment (sowing date 6th July) (91.25) was significantly superior over all other remaining treatments, because there is positive correlation between days to flowering and days to pod initiation and days to maturity. Smartt (1964) reported that in any given locality, early sowings in first fortnight of July resulted in early flowering and early maturity.

Days to harvesting :

The observations on days to harvesting as influenced by different dates of sowing were recorded and presented in Table 5. The number of days to harvesting was minimum (109) in 6thJuly sowing date (S_3) and (S_1) 22ndJune significantly lower than all other treatments. The second best treatment was S_2 sowing on 29thJune, which showed significant superiority over S_4 and S_5.Whereas, statistically highest number of days to harvesting (115) were recorded under S_5 during 20thJuly sowing. Thus, it can be concluded that the treatment sowing date (S_3) 6th July and treatment sowing date (S_1) 22nd June were significantly superior over all other remaining treatments, because there is positive correlation between days to flowering, days to pod initiation, days to maturity and days to harvesting. Similar result was recorded by Gritton and Ebert (1975) in the field trials conducted on peanut cultivars of early and late maturing varieties sown at seven days intervals and concluded that the July sowings emerged faster and required less time to reach flowering and early harvesting.

Yield contributing characters :

Number of mature pods plant-1 :

The data pertaining to number of nature pods plant-1 as influenced by different dates of sowing were recorded and presented in Table 6. The differences in number of mature pods plant-1 of groundnut were found significant due to different sowing date treatments. From the data summarized in Table 6 indicated that the sowing date 6th July recorded significantly more number of mature pods plant-1 (23.88) over all other treatments. The increased number of mature pods plant-1 with this treatment might be attributed to significant improvement in growth and yield attributes. The maximum value of number of mature pods plant-1 was recorded in S_3 treatment followed by S_1 during 22ndJune. It might be due to better plant growth. Whereas, statistically lower number of mature pods plant-1 (12.46) was recorded under S_5 during 20thJuly sowing. Thus, it can be concluded that the treatment sowing date (S_3) 6th July (23.88) was found significantly superior over all other remaining treatments. Similar results were observed by Murthy and Rao (1986) who studied that in India, sowing of rainfed and irrigated crop early in the season provided favorable weather conditions for proper growth and yield of groundnut. Delay in sowing by one week from 17th July to 24th August resulted in linear decrease in pod yield of groundnut and number of mature pods plant-1.

Wet pod weight kg plot-1 and q ha-1 :

The observations on wet pod weight kg plot-1 and q ha-1 as influenced by different dates of sowing were recorded and presented in Table 6. Among the various sowing date treatments, the wet pod weight plot-1 differed statistically and differences were found to be significant. The statistically highest wet pod weight was observed under S_3 during 6thJuly sowing date (4.23kg plot-1) and (36.83 q ha-1) than rest of the treatments.

However, the next best treatment was S_1 that is sowing the crop during 22nd June registered significantly highest pod yield and it was found to be at par with the treatment S_2 that is sown during 29thJune and treatment S_4 (13thJuly) for pod yield kg plot-1.This was closely followed by treatment S_2 that is sowing during 29thJune was found to be significant in both kg plot-1 and q ha-1, and it was found to be at par with the treatment S_4 in kg plot-1.The maximum yield in this treatment was might be due to maximum use of light and significantly well distributed rainfall and climatic conditions during crop growing period. Whereas, treatment S_5 (20thJuly) recorded significantly lowest pod yield of groundnut. Thus, it can be concluded that in the treatment sowing date (S_3) 6th July green pod weight was significantly superior over all other remaining treatments. Similar results were reported by Shantimalliah *et al*. (1979) who showed that pod yield of groundnut from early sowings was higher, and that groundnut could be sown upto the first fortnight of July without much reduction in yield.

Dry pod weight kg plot-1 and q ha-1 :

The data pertaining to dry pod weight kg plot-1 and q ha-1 as influenced by different dates of sowing were recorded and presented in Table 6. The differences in pod yield in kg plot-1 and q ha-1 were found significant due to different sowing date treatments under study. The significantly higher values of dry pod yield in kg plot-1

and q ha^{-1} was registered with sowing date (S_3) during 6th July than rest of the treatments. However, it was followed by treatment S_1 which registered highest pod yield and it was at par with treatment S_2 that is sowing during 29thJune in dry pod weight kg $plot^{-1}$. Whereas, treatment S_5 (20thJuly) recorded statistically lowest pod yield of groundnut (1.65 kg $plot^{-1}$ and 16.11 q ha^{-1}). Thus, it can be concluded that the treatment sowing date (S_3) 6th July was found significantly superior over all other remaining treatments in producing dry pod weight Similar results were reported by Lewin *et al*. (1979). They concluded that the crop sown on second fortnight of June gave the highest yield followed by the crop sown on July 7.

Conclusion :

Based on the response of groundnut to different dates of sowing in respect of growth, yield and influence of weather parameters on tikka and rust disease development. The following conclusions are drawn.

- Among the different dates of sowing, S_3 the sowing date (6th July), recorded significantly higher and favourable growth characters.
- The yield attributes like number of mature pods $plant^{-1}$, $yield^{-1}$ plot and ha^{-1}, wet weight $plot^{-1}$ and ha^{-1}, dry weight $plot^{-1}$ and ha^{-1} were also significantly influenced and improved in the same treatment *viz.,* S_3 that is sowing during 6thJuly.

It can be concluded from the existing study that, in the scenario of existing state of global warming and climate change, the appropriate sowing time of groundnut crop should be first week of July in Western Maharashtra and particularly in Pune region instead of earlier recommended sowing time of 15 June to 7 July which will help in obtaining comparatively higher pod yield

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