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Production potential of different groundnut varieties under varied dates of sowing in summer season

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Abstract
A field experiment was conducted during *summer* season at Agricultural Research Station, Kadiri, Acharya N.G. Ranga Agricultural University, Andhra Pradesh to study the production potential of groundnut varieties in varied dates of sowings in summer season. The soil having sandy loam texture and experiment was laid out in split plot design with three replications and 16 treatments combinations, where the main plots consisted of four varieties (V1: Kadiri 6, V2: Dheeraj, V3: Kadiri Amaravathi, V4: Kadiri Chitravathi) and four dates of sowing (D1: March 20th, D2: April 5th, D3: April 20th, May 5th). Four cultivars namely, Kadiri 6, Dheeraj, Kadiri Amaravathi and Kadiri Chitravathi were evaluated under four dates of sowings. Different cultivars sown under different dates of sowing exerted significant influence on the yield & yield attributes of summer groundnut. Among four cultivars sown on different dates of sowings, Kadiri Chitravathi recorded higher mean pod yield (2470 kg/ha) over different dates of sowing during summer which was on par with Kadiri Amaravathi (2271 kg/ha) and significantly superior over Dheeraj (2071 kg/ha) and Kadiri-6 (1782 kg/ha). Dheeraj recorded significantly superior over Kadiri-6 variety. Among different dates of sowing over different varieties, sowing at May 5th recorded higher mean pod yield (2560 kg/ha) which was on par with sowing at April 20th and significantly superior over March sowings. Pooled economic analysis of the study reveals that, mean highest gross returns (Rs.1,63,492/-), net returns (Rs.1,15,492/-) and benefit cost ratio (3.41) were with May 5th sowings over different varieties. May 5th sowing crop has realized 82 % higher net returns over March 20th sowing and 45 % higher net returns over April 5th sowing. The study reveals that, the optimum time of sowing for different groundnut varieties to realize maximum yield and returns is between April 20th to May 5th.

Keywords: Groundnut, summer season, varieties, dates of sowing, pod yield

Introduction
Groundnut is major oilseed crop in India and it plays a significant role in bridging the vegetable oil deficit within the country. Groundnut is known as “King of oilseeds”. Groundnut kernels are consumed directly as raw, roasted, fried or boiled and also used in culinary preparations like pea nut butter, peanut milk, peanut flour etc. Groundnut oil is edible oil containing oleic acids and linoleic acids (Sardana and Kandhola, 2007) [3]. Groundnut cake is used as feed to cattle as well as manure, as it contains 7-8 % of Nitrogen, 1.5 % of Phosphorus and 1.2 % of Potassium and its haulms are used as cattle feed. Groundnut is mainly grown as a rainfed crop during *kharif* season, but also grown in the *rabi/summer* season, wherever the irrigation facilities are available. Because of decreasing per capita availability of land, due to increase in population and urbanization, it is not possible to expand the cultivable area and hence it is necessary to employ low-cost technologies for improving groundnut yield through natural resource management. The sowing time plays an important role among various agronomic factors, which influencing the yield of groundnut. Optimum time of sowing will have longer growth duration which, consequently provides an opportunity to accumulate more biomass as compared to early or late sowing, hence manifested in higher economic and biological yield. Productivity of groundnut with different dates of sowing can be related to the effect of photothermal quotient. Change in the optimum temperature during its vegetative or reproductive growth adversely affect the initiation and duration in different phenophases and finally yield of the crop (Vinu *et al*., 2020) [4]. Among the different agronomic practices proper time of sowing is a most important factor and it is a non-cash input, about which the information is to be find out for obtaining maximum yield. Summer season is the best period to realize highest productivity of groundnut due to low risk of cyclonic crop damage, less incidence of pests and diseases besides higher photosynthetic rate in this season. Some newly developed varieties of groundnut especially bunch type varieties give good response in *summer* season under irrigated conditions. Sometimes farmers faced problems regarding early monsoon at the time of harvesting. So, timely sowing is necessary for particular variety in case of summer season. Keeping this in mind, the research has been taken up. This research paper will provide valuable insights into the interaction between sowing time and variety selection, contributing to the development of effective strategies for maximizing productivity and meeting the increasing global demand for edible oil.

Materials and Methods
A field experiment was conducted during three consecutive years (2019-20, 2020-21 and 2021-22) during *summer* season at the Agricultural Research Station, Kadiri of Acharya N. G Ranga Agricultural University (ANGRAU) in the scarce rainfall zone of Andhra Pradesh. The soil of the experiment field was sandy loam in texture (alfisols), neutral in PH (7.4), low in organic carbon (049), available

nitrogen (176 kg/ha) and available phosphorus (28 kg/ha) and medium in available potassium (299 kg/ha). The experiment was laid out with 16 treatment combinations in split plot design with three replications. Four different varieties (V1: Kadiri 6, V2: Dheeraj, V3: Kadiri Amaravathi, V4: Kadiri Chitravathi) were assigned to main plots treatments and four different dates of sowing time (D1: March 20th, D2: April 5th, D3: April 20th, May 5th) were assigned to sub plot treatment. Recommended dose of nitrogen, phosphorus and potassium (N: P_2O_5: K_2O @ 30-40-50 kg/ha) was applied through urea, single super phosphate and muriate of potash in addition to Gypsum @200 Kg/ha. Groundnut was sown @150 kg/ha seed in rows 22.5 cm apart and 10 cm plant to plant spacing. While harvesting of the crop in the net plot, ten plant were harvested separately for assessing individual plant yield. The growth parameters and yield parameters were studied. The data recorded on various parameters of crop was subjected to statistical scrutiny by the method of analysis of variance as outlined by Panse and Sukhatme (1985) [5]. Statistical significance was tested by 'F' value at 5 % level of probability and wherever the 'F' value was found significant, critical difference (CD) was worked out at 5 % level of probability and the values are furnished. The treatmental difference that were non-significant are denoted as NS.

Results and discussions

Various factors related to crop production played a crucial role in increasing groundnut production per unit area. Among these factors, the sowing time and the selection of suitable varieties were particularly important in maximizing production. The objective of the experiment was to find out the effect of sowing time and suitable varieties on growth, yield attributes and yield of summer groundnut. To achieve the aforementioned objectives, the results and discussion of various parameters are presented below in Tables 1, 2 and 3. Different cultivars sown under different dates of sowing exerted significant influence on the yield & yield attributes of summer groundnut. Three years pooled data reveal that, among four groundnut varieties, Kadiri Chitravathi recorded higher mean pod yield (2470 kg/ha) over different dates of sowing during summer which was on par with Kadiri Amaravathi (2271 kg/ha) and significantly superior over Dheeraj (2071 kg/ha) and Kadiri-6 (1782 kg/ha) (Table.1). Dheeraj recorded significantly superior over Kadiri-6 variety. This might be due to having superior genetic makeup of Kadiri chitravathi as compare to other two varieties of this experiment. This is because of having more dense plant canopy, stay greenness and a greater number of branches as compare to other varieties. Among different dates of sowing over different varieties, sowing at May 5th recorded higher mean pod yield (2560 kg/ha) which was on par with sowing at April 20th and significantly superior over April first fortnight and March sowings (Table.1). Haulm yield and yield attributes of different varieties *viz*., number of pods per plant, hundred pod weight, hundred kernel weight and shelling percentage were also significantly superior at May 5th and April 20th sowings over rest of dates of sowing (Table.2). Higher pod yield of groundnut in May 5th sowing across the varieties was due to higher number of pods per plant and higher size, weight of kernels. This might be due to higher photosynthetic rate of the varieties in this date of sowing because of optimum weather conditions particularly higher sun shine hours coinciding with pod filling stage of the crop compared to April and March sowings. Significantly the highest number of days to maturity (117 days) was observed when crop was sown at May 5th. Proper distribution of moisture during critical growth period of the crop and long day conditions exposed the crop to better sunlight for longer duration produces more photosynthates for growth and development of the plant (Sai *et al*., 2022) [2]. Kamble *et al*., 2023 [1] also reported increased groundnut plant dry biomass with delayed sown crop due to congenial environmental conditions.

Pooled economic analysis of the study reveals that, mean highest gross returns (Rs.1,63,492/-), net returns (Rs.1,15,492/-) and benefit cost ration (3.41) were with May 5th sowings across different varieties. May 5th sowing crop has realized 82 % higher net returns over March 20th sowing and 45 % higher net returns over April 5th sowing. Further, highest gross (Rs.1,58,519/-) returns, net returns (Rs.1,10,519/-) and benefit cost ratio (3.30) was realized with Kadiri Chitravathi variety followed by Kadiri Amaravathi (Table.3).

Conclusion

From this study, it can be concluded that, higher production potential and economic returns of summer groundnut can be realized using Kadiri Chitravathi or Kadiri Amaravathi varieties duly adjusting the date of sowing between April 20th to May 5th. In sandy loam soils of scarce rainfall zone of Andhra Pradesh.

Table 1: Growth and Pod yield of different groundnut varieties under varied dates of sowings (Pooled data over 3 years)

Treatments	Pod yield (kg/ha)				Haulm yield (kg/ha)				No. of Pods/ plant			
	2019-20	2020-21	2021-22	Pooled	2019-20	2020-21	2021-22	Pooled	2019-20	2020-21	2021-22	Pooled
Main Treatments												
V1: Kadiri 6	1151	1955	2240	1782	1728	2644	3050	2474	13.8	13.4	21.7	16.3
V2 : Dheeraj	1669	2052	2498	2073	2439	2755	3560	2918	17.8	16.8	22.8	19.1
V3 : Kadiri Amaravathi	2122	2160	2532	2271	3109	2863	3467	3146	20.3	20.3	23.8	21.5
V4 : Kadiri Chitravathi	2494	2255	2661	2470	3527	3050	3940	3506	25.5	23.5	26.3	25.1
SEm ±	122	25.2	67.4	71.5	173	25.9	87.2	95.4	1.5	1.4	0.9	2.7
CD (P=0.05)	430	95	168	231	610	91.7	217	306	5.4	3.2	2.4	3.7
CV (%)	8.9	9.6	8.8	9.1	9.7	9.2	11.4	10.1	8.5	9.8	8.6	9.0
Sub Treatments												
D1 : March 20th	1468	1591	2137	1732	1988	2281	3494	2588	15.3	15.3	20.3	17.0
D2 : April 5th	1594	2010	2342	1982	2392	2699	3705	2932	18.5	17.5	21.9	19.3
D3 : April 20th	2142	2445	2748	2445	3076	2934	3300	3103	19.8	19.1	25.1	21.3
D4 : May 5th	2231	2575	2874	2560	3347	3397	3555	3433	23.7	23.7	27.3	24.9

SEm ±	96	24.3	87.1	69.1	164	24.5	119	102.5	1.1	1.6	1.44	1.38
CD (P=0.05)	282	165	182	210	481	72.1	248	267	3.4	3.6	2.9	3.3
CV (%)	9.1	10.8	11.6	10.5	9.4	10.2	14.2	11.3	8.6	9.2	7.4	8.4
Interaction: V×D												
SEm ±	206	49.1	68	107.7	345	49.8	120	171	3.0	3.0	1.0	2.3
CD (P=0.05)	NS	151.9	148	150	NS	NS	262	262	NS	NS	2.2	2.2

Table 2: Yield attributes of different groundnut varieties under varied dates of sowings (Pooled data over 3 years)

Treatments	Hundred pod Weight (g)				Hundred Kernel Weight (g)				Shelling %			
	2019-20	2020-21	2021-22	Pooled	2019-20	2020-21	2021-22	Pooled	2019-20	2020-21	2021-22	Pooled
Main Treatments												
V1: Kadiri 6	94.6	103.6	97.9	98.7	34.5	37.4	36.5	36.1	55.7	62.8	70.1	62.9
V2 : Dheeraj	100.8	106.8	99.3	102.3	37.2	38.6	38.6	38.1	58.4	64.3	72.1	64.9
V3 : Kadiri Amaravathi	101.4	109.5	108.0	106.3	38.0	39.0	40.2	39.1	59.3	67.3	71.2	65.9
V4 : Kadiri Chitravathi	105.0	111.1	107.0	107.7	40.3	40.0	39.9	40.1	60.5	68.3	70.3	66.4
SEm ±	3.3	2.3	1.85	2.5	0.3	0.2	0.89	0.46	1.4	0.2	0.84	0.81
CD (P=0.05)	11.9	NS	4.6	8.2	1.1	1.0	2.2	1.4	NS	NS	NS	NS
CV (%)	7.8	8.6	7.4	7.9	5.4	6.8	7.4	6.5	5.2	6.9	5.0	5.7
Sub Treatments												
D1: March 20th	94.4	98.5	96.5	96	35.5	37.1	37.5	36.7	52.8	62.6	67.2	60.9
D2: April 5th	97.2	101.6	101.2	100	36.9	38.2	38.2	37.8	56.9	64.1	68.6	63.2
D3: April 20th	101.5	109.8	105.8	106	38.4	39.3	40.3	39.3	59.8	67.0	73.1	66.6
D4: May 5th	108.8	127.2	108.8	115	39.3	40.3	41.8	40.5	61.4	69.0	74.8	68.4
SEm ±	3.3	3.1	2.13	2.84	0.7	0.3	1.23	0.74	1.3	0.23	1.53	1.02
CD (P=0.05)	9.9	9.9	4.4	8.1	2.1	1.1	2.5	1.9	3.2	0.68	3.2	2.4
CV (%)	8.4	9.3	8.2	8.6	5.2	6.2	6.1	5.8	5.7	8.3	5.9	6.6
Interaction: V × D												
SEm ±	6.7	4.7	1.75	4.38	1.3	1.3	1.20	1.2	2.9	0.4	1.29	1.53
CD (P=0.05)	NS	NS	3.8	3.8	NS	NS	2.6	2.6	NS	1.14	2.8	2.0

Table 3: Pooled economics of different groundnut varieties under varied dates of sowings. (Pooled data over 3 years)

Treatments	Gross Returns (Rs/ha)	Net Returns (Rs. /ha)	Benefit Cost Ratio
Main Treatments:			
V1: Kadiri 6	1,14,143	66,143	2.38
V2 : Dheeraj	1,32,943	84,943	2.77
V3 : Kadiri Amaravathi	1,45,438	97,438	3.03
V4 : Kadiri Chitravathi	1,58,519	1,10,519	3.30
Sub Treatments:			
D1: March 20th	1,11,674	63,674	2.33
D2: April 5th	1,27,675	79,675	2.66
D3: April 20th	1,55,445	1,07,445	3.24
D4: May 5th	1,63,492	1,15,492	3.41

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