Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(5): 2211-2213
Received: 13-07-2020
Accepted: 05-08-2020

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Effect of dates of sowings on growth and productivity of different cultivars of groundnut (*Arachis hypogaea* L.)

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Abstract
Field experiment was conducted at Agricultural Research Station, Kadiri, ANGRAU to study the influence of sowing windows on growth and yield of groundnut cultivars under rainfed conditions during *Kharif* season of 2016-17, 2017-18 and 2018-19 on sandy loam soil. Four groundnut cultivars *viz.*, Dharani, Kadiri-6, Kadiri-9 and Kadiri Harithandra were evaluated under four sowing windows *viz.*, first and second fortnights of June and July months. The experiment was laid out in Split plot Design and replicated thrice. The experimental results revealed that, highest mean pod yield was recorded with Kadiri-9 (1866 kg/ha) over the different dates of sowing and it was at par with Kadiri- harithandra (1790 kg/ha). While, among different sowing windows, highest mean pod yield was recorded at 1st fortnight of July (1905 kg/ha) which was at par with 2nd fortnight of June (1804 kg/ha) and significantly superior over the rest of the dates of sowings *i.e.*, 1st fortnight of June and 2nd fortnight of July.

Keywords: *Arachis hypogaea*, Kadiri, groundnut

Introduction
two replications with the objective of assessing the performance of newly developed okra hybrids for productivity and quality traits. Statistical analysis were done using Window Groundnut is an important oilseed crop grown under rainfed conditions. It is avery sensitive crop to climatic variations, especially rainfall, temperature and radiation (Banik *et al*., 2009) [2]. Prathima *et al.*, (2012) reported that the photosynthetic activity of the crop is severely affected under moisture stress conditions, which reduces the crop growth and development, thereby, reducing the pod yield. As the crop is grown under rainfed conditions, adequate soil moisture is required during pegging and pod development stages, to get better yield. Weather is very important among the various abiotic factors which influence groundnut crop growth and yield. Sowing date is an important production component that can be manipulated to counter the adverse effects of environmental stress. Matching the phenology of the crop to the duration of favorable conditions by selecting the most appropriate sowing dates to avoid the periods of stress is crucial for obtaining maximum yield. Adjustment of sowing date is very important to optimize climatic environment in respect to growth and yield of groundnut crop. This is accomplished through shifting sowings, so that any stress caused by environment is avoided during the critical stages of plant growth, but it requires detailed investigation of the growth dynamics of the crops under different dates of sowings. Hence, the present study was undertaken to compare the productivity of different groundnut cultivars under varied dates of sowings.

Materials and Methods
The field experiment was conducted with four varieties (Dharani, Kadiri-6, Kadiri-9 and Kadiri Harithandra) sown under four dates (June 1st FN, June 2nd FN,July 1st FN and July 2nd FN) in split plot design with 3 replications during *kharif*, 2016 to 2018 under rainfed situation at Agricultural research station, Kadiri. The soil of the experimental site was sandy loam and nutrients were applied @ 20-40-50 kg NPK ha^{-1} in the form of urea, SSP and MOP respectively along with 10 t of farm yard manure. Biometric observations were recorded by selected five plants from each plot randomly and marked with proper rotations. These plants were harvested at maturity separately for assessing individual plant yield. The growth parameters and yield parameters were studied. Pod and haulm yield was recorded from the net plot discording 60 cm plot at all four sides.

Results and Discussion

The weather parameters such as rainfall and sunshine played a critical role on the crop growth, which in turn decides the crop yield. Apart from the total amount of rainfall received, proper distribution of rainfall throughout the crop growth period is also important. The crop requires 400-500 mm of total rainfall. Among the sowing windows, the crop sown during I fortnight of July received 444.5 mm of total rainfall, which was well distributed in 33 rainy days. Pod filling and pod development stage, received (66 mm and 126.6 mm of rainfall, respectively).

The data pertaining to the haulm yield are presented in table 1. The genotype kadiri-9 recorded significantly higher haulm yield which might be due to better physio-morphological characters of Kadiri-9. Similar results were reported by Mohite *et al.*, (2017) [5]. Among the sowing windows, the crop sown during I fortnight of July recorded significantly higher haulm yield. This might be due to the proper distribution of rainfall during critical growth period of the crop and long day conditions exposed the crop to better sunlight for longer duration which produces more photosynthates for growth and development of the plant, during early sown conditions.

An insight in to the pooled results from three years showed that pod yield of groundnut varieties was varied at different dates of sowing. Among the dates of sowings, highest mean pod yield was recorded at 1st fortnight of July sowings (1905 kg/ha) over the four varieties and it was at par with 2nd fortnight of June (1804 kg/ha) which was significantly superior over the rest of the dates of sowings *i.e.*, 1st fortnight of June and 2nd fortnight of Julywhich was due to favorable weather conditions prevailed during crop growth period and similar findings were reported by Canavar and Kaynak (2008) [3] and Bala *et al*., (2011) [1]. Canavar and Kaynak (2008) [3] reported that pod yield of groundnut was affected by sowing time, with early sowing resulting in highest yields. Also, Laurence (1983) [6] reported that late sowing reduced pod yields by 19% (from 5.02 to 4.21 t/ha) compared with early sowing.

Among the four varieties, highest mean pod yield was recorded with Kadiri-9 (1866 kg/ha) over the different dates of sowing and it was at par with Kadiri- harithandra (1790 kg/ha).The interaction effect is also significant. Highest mean pod yield was recorded with Kadiri-9 variety at 1st fortnight of July sowings which was on par with Kadiri harithandra, Kadiri-6 variety sown during 1st fortnight of July, 2 nd fortnight of June and July. Whereas, interaction effect was found non significant regarding haulm yield and other yield attributes. The longer growing season in early sowing time resulted in a better pod yield performance. This result confirm the finding of Bala *et al*. (2011) [1] who reported that delayed sowing delayed 50% flowering and groundnut plants accumulated less dry matter as sowing was delayed. Canavar and Kynak (2010) [4] also opined that short- day conditions reduces the crop growth period and unsuitable conditions like lack of rainfall under delayed sowing are unfavourable to the crop growth due to stressed conditions and thereby, reduces the pod yield. Early sowing of groundnut rarely experiences moisture stress during reproductive stage, especially pod development stage under normal rainfall distribution and was found to be more beneficial compared to delayed sowing (Patel *et al.*, 2013).

Thus, it can be concluded that, sowing of I fortnight of July can produce higher pod yield due to better vegetative growth, which can translocate photosynthates to the sink and can escape moisture stress conditions during critical growth period.

Table 1: Yield of different groundnut varieties under varied dates of sowings. Pooled results (*kharif*, 2016-17 to 2018-19)

Treatments		Pod yield (kg ha^{-1})				Haulm yield (kg ha^{-1})			
		2016	2017	2018	Mean	2016	2017	2018	Mean
Main Plots:									
V1	Dharani	391	3512	740	1548	1485	2827	2182	2164
V2	Kadiri 6	331	2973	1536	1613	1397	2394	2348	2046
V3	Kadiri 9	350	3955	1295	1866	2168	3473	2451	2697
V4	Kadiri Harithandra	341	3859	1170	1790	1615	3525	2621	2587
	CV (%)	8.8	13.1	11.6	12.3	12.4	11.2	10.8	10.4
	SEm±	36	116	32	45	71.9	80	40	57
	CD (P=0.05)	NS	408	114	168	253.7	282	142	158
Sub Plots:									
D1	June 1st FN	498	3319	725	1514	2450	4148	2303	2967
D2	June 2nd FN	291	3763	1360	1804	1870	2824	2287	2327
D3	July 1st FN	321	3856	1540	1905	1110	2933	2616	2219
D4	July 2nd FN	304	2960	1520	1596	1298	2315	2397	2003
	CV (%)	9.2	12.2	10.2	11.8	10.8	12.3	8.6	11.2
	SEm±	30.5	81	35	52	83.5	90	65	75
	CD (P=0.05)	89.5	237	104	121	245.3	265	192	215
Interaction: V × D									
	SEm±	71.4	231	69	71	143.9	160	120	145
	CD (P=0.05)	NS	512	204	178	510.1	NS	NS	NS

Table 2: Yield attributes of different groundnut varieties under varied dates of sowings. Pooled results (*kharif*, 2016-17 to 2018-19)

Treatments		No of pods plant^{-1}				Hundred pod weight (g)			
		2016	2017	2018	Mean	2016	2017	2018	Mean
Main Plots:									
V1	Dharani	4.4	26.5	8.5	13.1	60.6	100	77.3	79.3
V2	Kadiri 6	3.2	24.1	12	13.1	51.0	110.1	81.5	80.8
V3	Kadiri 9	5.8	32.2	14.3	17.4	57.9	87.2	72.8	72.6
V4	Kadiri Harithandra	4.5	27.7	13.2	15.1	57.8	103.1	73.5	78.1

	CV (%)	9.8	7.2	8.4	9.2	8.8	6.8	7.2	7.8
	SEm±	0.6	2.2	0.6	3.8	1.8	1.7	1.2	2.2
	CD (P=0.05)	NS	7.7	NS	9.2	6.2	6.1	2.9	5.5
Sub Plots:									
D1	June 1st FN	5.2	27.1	9.3	13.8	64.9	100.6	74.2	79.9
D2	June 2nd FN	4.8	28	13.3	15.3	54.1	102.2	75.1	77.1
D3	July 1st FN	3.6	35	14.4	17.6	47.8	105.7	80.9	78.1
D4	July 2nd FN	4.1	20.3	12.9	12.4	60.4	91.7	75.1	75.7
	CV (%)	8.6	9.2	10.1	11.4	8.6	9.2	9.6	10.1
	SEm±	0.3	1.3	0.5	1.8	2.1	1.8	1.5	1.8
	CD (P=0.05)	0.9	3.9	1.3	4.5	6.2	5.3	3.8	4.6
Interaction: V × D									
	SEm±	1.1	4.5	1.1	2.1	3.5	3.5	2.8	3.4
	CD (P=0.05)	NS	NS	NS	NS	12.9	NS	NS	NS

Table 3: Yield attributes of different groundnut varieties under varied dates of sowings. Pooled results (*kharif*, 2016-17 to 2018-19)

Treatments		Hundred kernel weight (g)				Shelling %				SMK %			
		2016	2017	2018	Mean	2016	2017	2018	Mean	2016	2017	2018	Mean
Main Plots:													
V1	Dharani	27.8	27.8	34.0	29.8	75.7	79.0	64.9	73.2	79.9	94.9	87	87.2
V2	Kadiri 6	23.7	23.7	34.4	27.2	67.5	76.9	67.2	70.5	79.0	92.1	89	86.7
V3	Kadiri 9	27.4	27.4	31.6	28.8	68.1	77.3	65.8	70.4	78.9	92.6	90	87.1
V4	Kadiri Harithandra	25.9	25.9	31.0	27.6	67.7	71.8	62.8	67.4	74.4	90.2	87	83.8
	CV (%)	10.2	11.2	10.8	9.8	9.4	10.6	9.6	9.2	8.4	7.9	8.2	6.8
	SEm±	0.8	0.8	0.5	1.1	3.1	0.4	1.1	0.9	3.0	1.4	1.0	1.6
	CD (P=0.05)	2.7	2.7	1.5	2.8	NS	1.5	NS	NS	NS	NS	NS	NS
Sub Plots:													
D1	June 1st FN	31.9	31.9	32.5	32.1	66.1	75.8	63.8	68.5	79.9	92.3	87	86.4
D2	June 2nd FN	18.5	18.5	32.6	23.1	49.5	77.0	64.1	63.5	60.8	94.0	88	80.9
D3	July 1st FN	25.6	25.6	33.9	28.3	84.6	77.4	67.8	76.6	82.7	92.1	91	88.6
D4	July 2nd FN	28.7	28.7	32.0	29.8	78.8	74.7	64.9	72.8	88.9	91.4	86	88.7
	CV (%)	9.7	10.8	8.5	10.4	11.6	9.6	8.5	9.2	10.2	702	8.0	8.2
	SEm±	1.0	1.0	0.4	2.1	2.5	0.5	0.9	1.6	2.3	0.9	0.9	1.2
	CD (P=0.05)	2.9	2.9	NS	5.3	7.4	1.3	2.5	4.6	6.6	NS	2.6	3.0
Interaction: V × D													
	SEm±	1.5	1.5	1.0	1.6	6.2	0.8	1.8	2.4	6.0	2.8	1.8	1.5
	CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	14.3	NS	NS	NS

Table 4: Pod yield (kg ha^{-1}) of different groundnut varieties under varied dates of sowing Pooled results (*kharif*, 2016-17 to 2018-19)

	June 1st FN	June 2nd FN	July 1st FN	July 2nd FN	Mean
Dharani	1424	1642	1612	1515	1548
K-6	1395	1786	1949	1325	1613
K-9	1538	1995	2065	1865	1866
Kadiri Harithandra	1695	1795	1995	1678	1790
Mean	1514	1804	1905	1596	
Factors	C.D.		SE(m)±		
Variety	168		45		
Dates of sowing	121		52		
V × D	176		71		

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