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Effect of sowing times and varieties on growth and yield of summer groundnut (*Arachis hypogaea* L.)

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Abstract
An experiment entitled, "Effect of sowing times and varieties on growth and yield of summer groundnut (*Arachis hypogaea* L.)" was conducted during summer 2015 at Post Graduate Research Farm, College of Agriculture, Kolhapur. The objective of experiment is to study the optimum sowing time and varieties of groundnut under summer condition. The experiment was laid out in split plot design *viz*. sowing dates(52nd MW, 2ndMW, 4th MW, 6th MW) as main plot and four varieties (JL-501, JL-24, JL-286 and TAG-24) as sub plot with three replications. The gross and net plot size were 4.50 x 3.00 m^2 and 3.50 x 2.40 m^{2}respectively. The type of soil of the experimental field was sandy clay loam in texture. It was low in available nitrogen (235.93 kg ha^{-1}), moderately high in available phosphours (22.80 kg ha^{-1}), moderate in available potash (253.19 kg ha^{-1}) and was slightly alkaline in reaction. The growth and development of groundnut measured in terms of plant height, number of functional leaves, number of branches, leaf area and total dry matter per plant was observed to significantly higher when sowing was done on 2nd MW. The yield contributing character such as number of developed pods plant^{-1}, weight of pods plant^{-1}, was significantly higher when crop sown on 2nd MW. The dry pod yield (35.61 q ha^{-1}) was also maximum when crop sown on 2nd MW. Similarly, the yield of kernel (31.01 q ha^{-1}), oil content in kernel (48.54 %) and oil yield (10.38 q ha^{-1}) were the highest when the crop was sown on 2nd MW. Being a bunch type variety, the height of plant was significantly higher in JL-501 while number of functional leaves, leaf area plant^{-1}, number of branches, dry matter accumulation was higher in variety JL-501 followed by TAG-24. The yield attributing characters like number of pod plant^{-1} was maximum in variety JL-501 while it was minimum in JL-24. The weight of 100 kernel was higher in JL-501 (57.55 g), shelling percentage, kernel yield was also higher in variety JL-501. The dry pod yield given by JL-501 (34.84 q ha^{-1}) was maximum among the varieties JL-24 (29.26 q ha^{-1}) JL-286 (32.21 q ha^{-1}) and TAG-24-(33.91 q ha^{-1}). The dry haulm yield was significantly higher in variety JL-501 (31.21 q ha^{-1}). Higher oil content (48.67%), protein content (24.57%) and oil yield (10.32 q ha^{-1}), protein yield (7.35 q ha^{-1}) was also recorded by JL-501 as compared to other varieties.

Keywords: *Arachis hypogaea* L, phosphours, protein content

Introduction
The Groundnut is a valuable food and oilseed crop. It is commonly called as the king of vegetable oilseeds crops or poor man's nut. It belongs to family Leguminoceae. Groundnut appeared to have originated in South America i.e. At the global level 50 per cent of the groundnut produced is use for oil extraction, 37 per cent for confectionary use and 12 per cent for seed purpose. In India, 80 per cent of the groundnut produced is used for oil extraction, 11 per cent as seed, 8 per cent used as direct food and only 1 per cent of groundnut produce is exported (www.icrisat.com). The byproduct of this crop like haulm is rich in protein content (10-12%) and palatable are used as nutritious feed for cattle. As groundnut belongs to leguminoceae family it maintains the soil fertility by fixing the atmospheric nitrogen which fulfills its requirement and also released in soil which is useful for succeeding crops. The cultivation of crop can be good under well irrigation during summer. Most of the dugout wells are recharged due to monsoon rains and it is possible to apply 3-5 irrigation or the crop during summer. Sowing time is also important as temperature is the main factor deciding successful production of crop during summer.

Material and Methods
The field experiment was conducted during the summer season of the year 2015 at Post Graduate Research Farm, Agriculture college, Kolhapur which is situated between 16°41.548' North latitude and 74°16.329' East longitude. The altitude is 548 meter above mean sea level. The ecologically this area comes under sub zone with annual rainfall range of 1700 to 2500 mm with the average rainfall of 1057 mm.

mean maximum temperature recorded during crop growth period ranged in between 27.9°c to 36.6°c and minimum temperature recorded during crop growth period ranged in between 9.2°C to 23°C. The relative humidity during the morning and evening ranged in between 78 to 93.2 per cent and 26.7 to 81.4 per cent, respectively. The total rainfall received during the period of experimentation was 235.2 mm during 52nd, 2th and 4th to 6th meteorological week. Mean maximum evaporation recorded was 8.7 mm per day and minimum being 3.4 mm per day. The mean wind velocity recorded during the period of experimentation was in between 2.6 to 9.6 km^{-1}. The mean maximum sunshine hours recorded per day were 9.8 hrs and minimum 5 hrs. The growing degree days computed during the period of experimentation was ranged between 42.15 to 27.1 GDD. Experiment was laid out in split plot design with three replication. The 16 treatment combination comprising of four sowing dates in main plot and four varieties as sub plot treatments. The treatment details are A) Main Plot treatments: a) Meteorological weeks (Sowing Dates) D_1: 52nd MW (25 Dec. to 31 Dec.), D_2: 2nd MW (8 Jan. to 14 Jan.), D_3: 4th MW (22 Jan. to 28 Jan.), D_4: 6th MW (5 Feb. to 11 Feb.), B) Sub. Plot treatment: a) Groundnut varieties. V_1-JL-501, V_2- JL-24, V_3 - JL-286, V_4 - TAG-24. Sowing was carried out by dibbling two seed per hill with spacing of 30×10 cm^2. The seeds were covered immediately after sowing. The sowing was carried out at four different times as per sowing dates. Recommended dose of fertilizer i.e. 25: 50: 00 kg. N, P_2O_5, and K_2O per hectare were applied in splits as basal and N, and P_2O_5 per hectare. Five plants from each net plot were randomly selected and labeled for taking biometric observations at every 14 days interval commencing from 28 days onwards after sowing. The same five plants were harvested separately for post harvest studies. Plant height (cm), Number of functional leaves per plant, Number of branches $plant^{-1}$, Leaf area per plant (dm^2), Final plant count, Dry matter per plant, Post harvest studies is Number of pod $plant^{-1}$, Weight of pods $plant^{-1}$ (g), Hundred kernel weight (g), Pod yield $plant^{-1}$ (g), Pod yield (q ha^{-1}), Haulm yield $plant^{-1}$ (g), Haulm yield (q ha^{-1}) Quality studies of seed is Oil content (%).

Results and conclusion

Regarding Post Harvest Studies Effect of sowing dates It is revealed from the data that the number of pods plant-1 was affected significantly due to different dates of sowing. The number of pods plant-1was maximum with 2nd MW sowing which was significantly higher than rest dates of sowing (42.20), and at par with 4th MW (40.55). The number of pods were decreased with delayed sowing. Result are corroborated with those reported by Lodh (1992) [4].

Table 1: Mean number of pods $plant^{-1}$, pod yield $plant^{-1}$ (g), and number of kernels pod^{-1} as influenced by different treatments at harvest

Treatments	No. of Pods $plant^{-1}$	Pod yield $plant^{-1}$ (g)	No. of kernels pod^{-1}
Main Plot (Sowing Dates)			
D_1= 52nd MW	37.63	33.58	2.53
D_2= 2nd MW	42.20	36.02	2.66
D_3= 4th MW	40.55	35.32	2.54
D_4= 6th MW	36.62	33.10	2.38
S.E. ±	1.38	0.51	0.05
CD at 5%	3.45	1.76	0.18

Effect of sowing dates The pod yield $plant^{-1}$ was influenced significantly due to various dates of sowing. Sowing on 2nd MW produced maximum yield of pods (36.02 g) $plant^{-1}$ which was significantly higher than other dates of sowing but on par with 4th MW (35.32 g). Weight of pods $plant^{-1}$ was decreased with delayed sowing. The weight of pods $plant^{-1}$ was significantly lowest (33.10 g) with sowing on 6thMW. Better soil aeration, abundant availability of nutrients, moisture, Co_2, sunlight for the groundnut crop helped in increasing the yield in the above sowing dates. Effect of sowing date The number of kernels pod^{-1} differed significantly due to various dates of sowing. Sowing on 2nd MW produced maximum kernels pod^{-1} which was significantly superior than other dates of sowing but comparable with 52nd MW and 4th MW. The number of kernels pod^{-1} was decreased with delayed sowing on 6th MW. Effect of sowing dates. The haulm yield was influenced significantly due to various dates of sowing. Sowing on 2nd MW produced maximum haulm yield $plot^{-1}$ (3.43 kg) which was significantly superior over other dates but on par with 4th MW (3.27 kg) of sowing. The haulm yield $plot^{-1}$ was minimum with sowing on 6th MW (2.26 kg).The haulm yield was influenced significantly due to various dates of sowing. Sowing on 2nd MW produced maximum haulm yield at harvest which was significantly superior than other dates of sowing. Haulm yield was decreased as sowing was delayed and minimum with sowing on 6thMW. This results are found to be in close conformity with Kumar *et al.*, (2003) [3]. The hundred kernel weight was significantly influenced by different dates of sowing. The hundred kernel weight 48.48 g was maximum when sown on 2nd MW which was at par with the 4th MW (48.39 g) sowing dates. The 100 kernel weight was lower at 6th MW (46.30 g) and 52nd MW was (46.38 g) It is observed from the data, the various sowing dates did not affect the shelling per cent. The hundred kernel weight was significantly influenced by different dates of sowing. The hundred kernel weight 48.48 g was maximum when sown on 2nd MW which was at par with the 4th MW (48.39 g) sowing dates. The 100 kernel weight was lower at 6th MW (46.30 g) and 52nd MW was (46.38 g) It is observed from the data, the various sowing dates did not affect the shelling per cent.

Table 2: a) Mean 100 kernels weight (g), shelling percentage (%), pod yield (q ha^{-1}), kernel yield (q ha^{-1}) as influenced by different treatment at harvest.

Treatments	100 kernels weight (g)	Shelling per cent (%)	Pod yield (q ha^{-1})	Kernel Yield (q ha^{-1})
Main Plot (Sowing Dates)				
D_1= 52nd MW	46.38	72.12	31.29	22.56
D_2= 2nd MW	48.48	68.99	35.61	24.56
D_3= 4th MW	48.39	69.83	34.00	23.74
D_4= 6th MW	46.30	74.43	29.92	22.26
S.E. ±	0.40	1.13	0.56	0.65
CD at 5%	1.40	NS	1.93	2.26

The hundred kernel weight was significantly influenced by different dates of sowing. The hundred kernel weight 48.48 g was maximum when sown on 2nd MW which was at par with the 4th MW (48.39 g) sowing dates. The 100 kernel weight was lower at 6th MW (46.30 g) and 52nd MW was (46.38 g) It is observed from the data, the various sowing dates did not affect the shelling per cent. However, numerically shelling per cent (74.43%) was maximum when sown on 6th MW and minimum shelling per cent was (68.99%) on 2nd MW (72.12). The yield of dry pods differed significantly due to various dates of sowing. Sowing on 2nd MW yielded maximum dry

pods (35.61 q ha^{-1}) which was significantly superior however on par with 4th MW (34.00 q ha^{-1}). The sowing on 52nd MW, 6th MW gave significantly lower yields of dry pods as compared to sowing on 2nd MW. Similar results were reported by Bhosale *et al.* (1987) [1], Sardana and Kandhola (2007) [5]. The kernel yield was affected significantly due to different sowing dates. The kernel yield (31.01 q ha^{-1}) was maximum when sowing on 2nd MW, which was significantly superior than rest of the dates of sowing and at par with 4th MW and the 6th MW sowing gave lowest kernel yield (25.57 q ha^{-1})It is observed that the different dates of sowing did not affect the oil per cent. However, numerically maximum oil per cent (48.54%) was observed when sown on 2nd MW. Other sowing dates decreased the oil per cent in the kernels. Sowing on 6th MW gave the lowest oil per cent (47.77%). Similar result found by Sardana and Kandhola (2007) [5]. The yield differed significantly due to different sowing dates.

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