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Effect of sowing dates on performance of groundnut (*Arachis hypogaea* L.) cultivars in *Kharif* season under Prayagraj condition

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Abstract
Field experiment was conducted during Kharif season 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad, (U.P.) to study the influence of sowing windows on growth and yield of groundnut cultivars under rainfed conditions during Kharif season of 2020-21 on sandy loam soil. Three groundnut cultivars *viz*., GJG-32, GG-14, TAG 37A were evaluated under three sowing windows *viz*., second fortnight July, first and second fortnight of August months. The experiment was laid out in Randomized Block Design. There were nine treatments each replicated thrice. From the results, it was observed that the growth parameters *viz*., plant height (63.14 cm), dry weight (55.0 g/plant), number of nodules per plant (50.1), dry matter accumulation (1833.41g/m^2) were recorded highest in the treatment 2 was recorded with GJG-32+20th July. The yield parameters and yield *viz*., No. of pods per plant (31.72), shelling percentage (69.65%), Seed yield (2.91 t/ha), Haulm yield (4.77 t/ha),Seed index (34.07 g),No. of kernels per plant (1.93).The experimental results revealed that, highest mean pod yield was recorded with GJG-32 (2.91 t/ha) over the different dates of sowing and it was at par with GG-14 (2.81 t/ha).

Keywords: Date of sowing, varieties, growth, yield attributes, *Arachis hypogaea*, ground nut

Introduction
Groundnut (*Arachis hypogaea* L.) is a leguminous plant that is widely cultivated in the tropics and subtropics between 40°N and 40°S latitudes. It is valued for its high-oil edible seeds and as such, it is the fourth most important source of edible oil and a third most important source of vegetable protein in the world. Groundnut is not only an important oilseed crop of India but also an important agricultural export commodity. Groundnut covers 295 lakh hectares with the production of 487 lakh tonnes with the productivity of 1647 kg per hectare (FAOSTAT, 2019). With annual all-season coverage of 55.6 lakh hectares, globally, India ranks first in Groundnut acreage and is the second largest producer of Groundnut in the world with 101 lakh tonnes with a productivity of 1816 kg per hectare in 2020-21 (agricoop.nic.in). Groundnut is cultivated in one or more (kharif, rabi and summer) seasons, but nearly 80% of acreage and production comes from kharif crop (June- October).Groundnut seeds (kernels) contain 35.8-54.2% oil (Jambunathan *et al.* 1985), 16.2-36.0% protein (Dwivedi *et al.* 1990), and 10-20% carbohydrate (Salunkhe *et al.* 1992). The seeds are also a good source of minerals like calcium, phosphorus and iron and vitamins like E, niacin, folacin, riboflavin and thiamine. Groundnut haulms constitute nutritious fodder for livestock. They contain protein (8-15%), lipids (1-3%), minerals (9-17%), and carbohydrate (38-45%) at levels higher than those of the cereal fodders.

Therefore, to ascertain the influence of different weather conditions and rainfall distribution and its amount on the performance of groundnut productivity for Prayagraj region in Uttar Pradesh agro-climatic condition which receives an annual rainfall distribution of 600-900 mm, The state of Uttar Pradesh stands 8th in all the area, production, and productivity in India. Groundnut is cultivated over 101.0 hectares with a production of 100 tones with an average productivity of 9.94 qtl per hec (DOA,U.P.2019).

The time of sowing has a considerable influence on growth and yield of groundnut. Early sowing in the season may encourage higher vegetative growth which may invite various diseases and pests. However, delayed sowing may shrink the vegetative phase, which in turn reduces dry matter accumulation leading to poor partitioning to reproductive parts and ultimately poor realization of the potential yield.

The yield potentiality differs with varieties and agro-climatic conditions. The optimum time of sowing and promising varieties are the backbone to catch potential yield of groundnut. 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. A study was, therefore, conducted to assess the productivity of different varieties of groundnut at different sowing dates under agroclimatic conditions of Prayagraj.

Materials and Methods

The experiment was conducted during *Kharif* season of 2020-2021. The experiment was conducted in Randomized Block Design consisting of nine treatment combinations with three replications and was laid out with the different treatments allocated randomly in each replication. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.2) with low level of organic carbon (0.50%), available N (100.70 Kg/ha), P (18.70 kg/ha) and higher level of K (237.42 kg/ha) and available Sulphur (11.26 ppm). The treatment combinations are T_1 -20.07.2021+TAG 37A, T_2 - 20.07.2021 + GJG - 32, T_3 - 20.07.2021 + GG-14, T_4 - 05.08.2021 + TAG 37A, T_5 -05.08.2021 + GJG-32, T_6 - 05.08.2021 + GG-14, T_7 -20.08.2021 + TAG 37A, T_8 - 20.08.2021 + GJG-32, T_9 - 20.08.2021 + GG-14. Groundnut varieties. V_1-TAG-37A, V_2- GJG-32, V_3 – GG-14. 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 three different times as per sowing dates. Recommended dose of fertilizer i.e. 25: 50: 45 kg. N, P2O5, and K2O 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 labelled for taking biometric observations at every 15 days interval commencing from 15 days onwards after sowing. The same five plants were harvested separately for post harvest studies. Plant height (cm), Root Nodules $plant^{-1}$, Dry matter per plant, Final plant count, Post harvest studies is Number of pod $plant^{-1}$, Weight of pods $plant^{-1}$ (g), Hundred kernel weight (g), Pod yield (q ha^{-1}), Haulm yield (q ha^{-1}), Shelling Percentage (%), Test weight (g), Seed index (g), Harvest index (%).

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 500-600 mm of total rainfall. Among the sowing windows, the crop sown during II fortnight of July received 572 mm of total rainfall, which was well distributed in 48 rainy days. Among the dates of sowings, highest mean pod yield was recorded at 2nd fortnight of July sowings (2.91 t/ha) over the three varieties and it was at par with 1st fortnight of August (2.81 t/ha) which was significantly superior over the rest of the dates of sowings i.e., 2nd fortnight of August which was due to favourable weather conditions prevailed during crop growth period and similar findings were reported by Canavar and Kaynak (2008) [2] and Bala *et al*., (2011) [1]. Yusufali *et al.,* (2007) [22] that fodder cowpea sown during July II fortnight realized higher plant height (134.5 cm) as compared to crop sown during I fortnight of August (118.7 cm). Also, Laurence (1983) [10] reported that late sowing reduced pod yields by 19% (from 5.02 to 4.21 t/ha) compared with early sowing. Canavar and Kynak (2010) [3] 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.

Yield and yield attributes: Observation regarding yield and yield attributes were given in the table (2).

Numbers of per plant

The data given in Table 2 indicated that significantly higher numbers of pods per plant were recorded under GJG-32 variety (31.72). Number of pods per plant in GG-143 variety over TAG-37A (30.82) and GG-2 (23.51) varieties was to the tune of 5 and 26 per cent, respectively. The reason for maximum total number of pods per plant in GJG-32 may be attributed to its inherent ability with better genotype character. The present finding are in agreement with those reported by Kalaria and Sinha (1984) [8].

Kernel weight per pod

Total kernel weight per pods was significantly highest in GJG-32 (1.93) because of higher more number of mature pods per pods and total number of kernel per pods (Table 2). Similar results were reported by Parmar *et al*. (2011) [12]; Mane *et al*. (2010) [11]; Ravisankar *et al*. (2010) [14]; Sardanab and Kandhola (2009); Chandrika *et al*. (2008) [4]; Dhahge *et al*. (2008); Sesay *et al*. (2008) [19]; Vishwakarma *et al*. (2008) [21]; Thakare *et al*. (2006) [20]; Datke *et al*. (2003) [6]; Kalita *et al*. (2003) [9]; Rafey and Prasad (2003) [15]; Reddy *et al*. (2000) [13]; Rinjumoni (2000) and Suresha (2000) also reported similar type of results.

Pod yield

Significantly highest pods yield of groundnut (2.91t/ha) was recorded under GJG-32 which was statistically superior over GG-14 and TAG-37A. The higher yield under variety GJG-32 is due to more number of primary branches total pods weight per plant and test weight (Table 2) which gave maximum pods yield over rest of the varieties, another probable reason for higher pods yield by GJG-32 may be it might have utilized more nutrients. These finding are accordance with those reported by Gohil and Damane (1999) [7]. Higher pod yield in early sowing dates accrued mainly from increased number of pods per plant and 100-seed weight. Shelling outturn of crop sown on 20th July was significantly higher than that obtained in all other dates of sowing. The main reason for higher productivity of crop sown on 20th July and may be favourable

temperature, sunshine hours and humidity conditions during crop growth period Being a tropical crop, high temperature and long sunshine hours might have had beneficial effect in accumulating vegetative biomass and resource utilization whereas increasing relative humidity in the later part must have resulted in better development of sink. Rains in July–August seem to have added advantage for the early-sown crop in its post-anthesis period. Incidence of Cerocspora leaf spot/tikka disease starts in July and increases in August–September. At this stage, early-sown crop was in the reproductive phase and thus was not affected; whereas late-sown crop, particularly that sown in August, was affected to a great extent. Late sown crop is also caught up in the low temperature and dry weather conditions for considerable period after cessation of monsoon rains in mid-September. Frequent rains at the vegetative stage of end July sown crop may also have an adverse effect on reproductive growth due to proportionately more vegetative growth and poor development of sink. 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.

Table 1: Growth of groundnut varieties at different growth stages as influenced by times of sowing

	At harvest			
Treatments	**Plant height (cm)**	**Root nodules per plant**	**Dry weight (g)**	**Dry matter accumulation(g/m^2)**
1.20.07.2021+ TAG-37A	57.97	47.7	50.55	1685.00
2.20.07.2021+GJG-32	63.14	50.1	55.00	1833.41
3.20.07.2021+GG-14	60.34	43.2	52.31	1162.34
4.05.08.2021+ TAG-37A	56.55	39.6	48.22	1607.41
5.05.08.2021+ GJG-32	59.77	47.7	53.19	1772.92
6.05.08.2021+ GG-14	59.07	40.7	51.47	1143.88
7.20.08.2021+ TAG-37A	52.93	38	43.19	1439.78
8.20.08.2021+ GJG-32	57.65	41.1	50.80	1693.37
9.20.08.2021+GG-14	57.03	38.1	49.10	1091.16
F Test	S	S	S	S
S.Ed (±)	0.45	1.18	0.47	18.85
CD (p=0.05)	1.34	3.55	1.42	47.53

Table 2: Yield attributes of groundnut varieties as influenced by different times of sowing

Treatments	**No. of pods/plant**	**No. of kernels/pod**	**Shelling percentage (%)**	**Seed index (g)**	**Seed yield (t/ha)**	**Haulm yield (t/ha)**	**Harvest index (%)**
1.20.07.2021+ TAG-37A	23.51	1.60	65.93	29.93	2.05	3.43	37.40
2.20.07.2021+GJG-32	31.72	1.93	69.65	34.07	2.91	4.77	37.88
3.20.07.2021+GG-14	30.82	1.73	68.41	31.60	2.81	4.69	38.62
4.05.08.2021+ TAG-37A	23.19	1.47	63.31	26.97	1.92	3.27	37.01
5.05.08.2021+ GJG-32	24.62	1.87	66.74	32.58	2.65	4.48	37.21
6.05.08.2021+ GG-14	22.31	1.67	66.07	30.98	2.24	3.58	38.49
7.20.08.2021+ TAG-37A	19.20	1.33	61.70	25.16	1.75	3.00	36.88
8.20.08.2021+ GJG-32	23.25	1.60	65.98	29.37	2.57	4.16	38.21
9.20.08.2021+GG-14	20.99	1.53	64.30	28.67	2.08	3.43	37.70
F-Test	S	S	S	S	S	S	NS
S.Ed (±)	0.25	0.01	0.59	0.78	47.50	36.60	0.57
CD (p=0.05)	0.76	0.29	1.25	2.33	99.80	76.90	1.71

Haulm yield

The significantly highest haulm yield of groundnut (4.77 t/ha) was recorded under the GJG-32. Among the sowing windows, the crop sown during II 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.

Seed index

The data also indicated significantly higher seed index under GJG-32 (34.07) which was at par with GG-14(31.60). Similar result were reported by Kalaria and Sinha (1984) [8].

Shelling percentage (%)

It is observed from the data, the various sowing dates did not affect the shelling per cent. However, numerically shelling percent (69.65%) was maximum when sown on 20th July and minimum shelling per cent was (61.70%) on 2nd fortnight August.

Harvest index

Harvest index in three varieties was observed significantly higher in July 20th sowing. This difference brought out in growth characters by yield attributing characters and ultimately haulm and pod yields.

Economics

Economics was calculated based on market price of dry pod @ 3300.00 INR/q in the year 2021, respectively. The net returns and B: C ratios were numerically higher on 20 July sowing (1,06,897.00/ha and 2.01) in variety 'GJG-32' and 05 August sowing (92,430.00/ha and 1.73) in same variety 'GJG-32'. Minimum net returns was observed in 20th August

sowing (42397.00/ha) and B:C ratio (0.79) in variety 'TAG-37A'. This confirms the finding of Subrahmaniyan *et al*. (2008); Ravisankar *et al*. (2010) [17, 14].

Conclusion

Thus, it can be concluded that, sowing of II 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. 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).

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