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Effect of different sowing dates on growth and yield of chickpea (*Cicer arietinum* L.) under irrigated condition

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Abstract
This research aims to identify the appropriate sowing date for better yield of chickpea, The experiment was conducted during 2018-2019, involving three different sowing dates (24 Oct, 13 Nov and 3 Dec.) along with three different chickpea varieties, In this research yield and base characteristics were analysed. The study focused on yield elements, such as grain yield and biological yield, Date 24 Oct gave the highest yield (1631 kg ha^{-1}) with different sowing varieties. On the other hand, the date 3 Dec had the lowest yield (1220 kg ha^{-1}) with different Sowing varieties. The results showed that the sowing date influence significantly the growth and yield of chickpea.

Keywords: Chickpea, yield, plant growth, sowing date, variety

Introduction
Chickpea (*Cicer arietinum* L.) is the fifth most important legume in the world on the basis of total production after soybean, groundnuts, beans and peas. It is a main nutritive legume crop of rural and urban household of the poor in the developing world. It is an important source of cheap protein with high energy and nutritive value (El-Karamany and Bahr, 1999) [10]. It is a rich source of protein, carbohydrate, B-group vitamins, and certain minerals, particularly to the populations of developing nations. Chickpea being a leguminous crop improves soil fertility by fixing atmospheric nitrogen up to 99 kg/ha in available from (NH3 and NH4) in the root through the phenomena of symbiosis.
It is used in many forms as dal, chhole, sweets and many attractive dishes. Snacks are prepared from its flour. Its leaves contain malic and citric acid, which are very useful for stomach ailments and it is best blood purifier. Nutritionally, it is very rich as it contains about 18-22 percent protein, 62 per cent carbohydrate and good amount of fat; besides it is a rich source of Ca, Fe and vitamin C (in green stage) and vitamin B1.
Chickpea is largely cultivated in the temperate region. However, some studies show that it is grown across a wide range of environments. It is grown mainly in Central Asia, West Asia, South Europe, Australia and North Africa (Berger and Turner, 2007) [5]. Chickpea is a premier pulse crop of India grown in *rabi* season under various cropping systems. In India, it is grown on an area about 9.91 million hectares with an annual production of 8.22 million tonnes and average productivity is 895 kg ha^{-1} (Anonymous 2012) [4]. It contributes about 47% of the total pulse production and about 40% of total pulse growing area in the country. In India, it is mainly grown in the states of Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, etc. Among these states, Madhya Pradesh is the largest producer of chickpea, which covers 2.79 million hectares area with an annual production of 2.58 million tonnes and average productivity is 925 kg ha^{-1}.
Numerous environmental and genetic variables interact during the growing period of chickpea in determining its productivity. Among the various agronomic practices, sowing time is single most important factor influencing the yield of chickpea. Optimum sowing time of chickpea may vary from one variety to another and also from one region to another due to variation of agro-ecological conditions. Different planting dates subject the vegetative and reproductive stages of the plant to various temperature, solar radiation and day length (Yadav *et al*., 1999) [33]. The modified environments resulting from different planting dates influence the crop growth and development by subjecting the different phenological stages *viz*., germination, vegetative and reproductive stages of the plant to various temperature, solar radiation and day length. Chickpea is usually sown between mid October to mid November. However, sowings are often delayed when grown in sequence with *kharif* crops. The exposure of crop to low temperatures during germination and seedling establishment and to high temperature during flowering and seed formation phases under delay-sown chickpea results in drastic reduction in

yield. Yield loss in chickpea can vary between 30% and 60% depending on genotype, sowing time, location, and climatic conditions during sowing season. Some chickpea genotypes have capacity to tolerate drought and in that case sowing time can be delayed. However, earlier or late sowing caused drastic reduction in yield and net profit compared with timely sowing (Dixit *et al.,* 1993) [8].

Materials and methods

The experiment entitled, "Effect of sowing dates on growth and yield of Chickpea (*Cicer arietinum* L.) under irrigated conditions*"* was conducted in *rabi* 2018-19 at Research Farm, School of agricultural science, GHRU Saikheda, MP., Chhindwara district lies in the Madhya Pradesh State. It is situated in the southern part of Madhya Pradesh at 22.07' N latitude and 78.93' E longitude at an altitude of 675 meter mean sea level. It has sub-tropical climate characterized by hot dry summers and cool dry winter. The average maximum temperature during the month of May–June varies between 43.0 to 45.0 °C, while the average minimum temperature varies between 4 to 6 °C during December-January, which are the coldest months of the year. The average annual rainfall of this region is about 1000mm which is mostly received between June to September and a little rainfall (90 mm) is also obtained during October to May. The average humidity of the tract is about 70 percent. The meteorological data prevailed during crop season (*Rabi* 2018-19) was recorded at the Meteorological Observatory located at School of agricultural science, GHRU. Saikheda, MP. Farm. The experiment was laid out in split-plot design with three replications and allocating three dates of sowing (24 0ct, 13 Nov and 3 Dec 2018) to main plots and three varieties (G-63, L-550 and JG-16) to sub-plots.

After preparation of the field, the experiment was laid out. The recommended doses of nitrogen (20 Kg N ha^{-1}), phosphorus (40 Kg P2O5 ha^{-1}) and potassium (20 kg k2O ha^{-1}) were applied. Full dose of phosphorus, potassium and nitrogen were applied at the time of sowing. The source of nitrogen and phosphorus were urea (46 % N) and DAP (46% P2O5 and 18% N), respectively and source of potassium was murate of potash or KCL (60 % K2O). The chickpea crop was sown as per treatments in lines 30 cm apart drawn by *kudal i* using a seed rate of 80 Kg ha^{-1}. Irrespective of treatments, thinning of extra plant was done 25 days after sowing by hand pulling to obtain the recommended intra-row spacing of 15 cm. To eliminate weeds in all the plots of experimental area, two hoeings were done at 25 and 40 days after sowing. The crop was harvested manually with *hasiya* on different dates. Before harvesting, five plants already tagged were pulled out from every plot to record post harvest observations (yield attributes). The crop in net plots was harvested separately and left in the respective plots for sun dry. The crop was threshed by manual laborers and was weighed to get seed yield, straw yield and biological yield kg $plot^{-1}$. Thereafter, these yields were converted into kg ha^{-1}.

Population counts were recorded from a meter row length at 5 places in each plot at 30 DAS and at harvest. Thereafter, average was worked out and computed as plant population m^{-2}. The plant height of already tagged five plants was measured from the base of the plant up to growing shoot at 20, 40, 60, 80, 100 (DAS) and at physiological maturity in each plot. Thereafter, average plants height (cm) was worked out.

The number of primary branches was counted separately from five plants drawn for biomass observation at 20,40,60,80,100 (DAS) and at physiological maturity in each plot and their average (primary branches $plant^{-1}$) was worked out. After threshing the bunch of five plants, the number of seeds were counted and divided with total number of pods recorded from these five plants to obtain number of seeds (pod^{-1}). The crop harvested from net plot area of 4.0 m x 2.4 m (9.6 m^2) was threshed after 4-5 days of sun drying. The seed yield was then converted into $kgha^{-1}$. Before threshing of the crop harvested from net plot, the sun dried whole plant samples (biological yield) were weighed and then converted into kg ha^{-1}. The harvest index (HI) was calculated as per formula:

$$HI\ (\%) = \frac{\text{Seed yield/economic yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \times 100$$

Result & Discussion

The results of field study entitled, "Effect of different sowing dates on growth and yield of Chickpea (*Cicer arietinum* L) under irrigated conditions.

Sowing dates showed the variation in days for different growth stages from the very beginning. Days taken from sowing to various growth stages *viz*., emergence, first flower and first pod were increased significantly with the successive delay in sowing from 24 October to 13 November and 3 December. On the contrary, days taken to physiological maturity were reduced with delayed sowing.

The data related to seed yield (kg ha^{-1}) as influenced by different sowing dates are presented in Table 1. Data in Table 1 reveals that seed yield (kg ha^{-1}) was found to be significantly affected by different sowing dates and varieties. Among the different sowing dates, 24 October sown crop resulted into significantly higher seed yield(1631 kg ha^{-1}) followed by 13 November (1404 kg ha^{-1}) and 3 December (1220 kg ha^{-1}) sowing dates.

A successive delay in sowing from 24 October to 13 November and 3 December decreased the seed yield. Among different varieties, JG-16 exhibited significantly higher seed yield followed by *cvs*. L-550and G-63. Cultivar JG-16 produced significantly higher yield under 24 October followed by 13 November and 3 December sowing date. The data pertaining to biological yield (kg ha^{-1}) as influenced by sowing dates are summarized in Table 1. Data in Table 1 reveals that biological yield (kg ha^{-1}) was found to be significantly affected by sowing dates. Among different sowing dates, significantly higher biological yield was recorded in 24 October (4842 kg ha^{-1}) sown crop followed by 13 November (4386 kg ha^{-1}) and 3 December (3758 kg ha^{-1}) sowing dates.

The data pertaining to straw yield (kg ha^{-1}) as influenced by sowing dates are presented in Table 2. The trend of straw yield in different sowing date were similar as biological yield. 24 October sown crop resulted into significantly higher straw yield (2536 kg ha^{-1}) followed by 13 November (2324 kg ha^{-1}) and 3 December (1975 kg ha^{-1}) sown crops. Among different varieties, JG-16 exhibited significantly higher straw yield (2297 kg ha^{-1}) followed by *cvs*. L-550 (2278 kg ha^{-1}) and. G-63 (2260 kg ha^{-1}). However, straw yield between *cvs*.L-550 and G-63 differ significantly. The data pertaining to harvest index (%) as influenced by sowing dates are given in Table 2. It is clear from the data that sowing dates influenced the harvest index significantly.

Table 1: Effect of different treatments on seed yield (kg ha^{-1}) and biological yield (kg ha^{-1})

Treatments	Seed yield				Biological yield			
	Varieties				Varieties			
Date of sowing	G-63	L-550	JG-16	Mean	G-63	L-550	JG-16	Mean
24th Oct. 2018	1622	1630	1604	1631	4832	4838	4876	4842
13th Nov. 2018	1394	1402	1418	1404	4366	4385	4407	4386
3rd Dec. 2018	1189	1230	1242	1220	3738	3755	3780	3758
Mean	1402	1402	1433		4312	4326	4348	
	S.Em±		4.79		S.Em±		13.11	
	CD(P=0.05)		13.30		CD(P=0.05)		36.41	

Table 2: Effect of different treatments on straw yield (kg ha^{-1}) and harvest index (%)

Treatments	Straw yield				Harvest index			
	Varieties				Varieties			
Date of sowing	G-63	L-550	JG-16	Mean	G-63	L-550	JG-16	Mean
24th Oct. 2018	2420	2538	2551	2536	32.96	33.74	35.10	33.93
13th Nov. 2018	2304	2323	2346	2324	31.87	33.24	34.30	33.14
3rd Dec. 2018	1956	1974	1994	1975	31.53	32.78	34.27	32.86
Mean	2260	2278	2297		32.12	33.25	34.56	
	S.Em±		7.16		S.Em±		0.09	
	CD(P=0.05)		19.89		CD(P=0.05)		0.25	

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