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To study about the influence of different growing environments on yield attributes and yield of chickpea varieties in rabi season

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Abstract
A field experiment entitled to study about the influence of different growing environment son yield attributes and yield of chickpea varieties in rabi season was conducted at the Research and Instructional farm of IGKV, Raipur during Rabi2017-18. The treatments consisting three growing environments *viz*. 10 November, 25 November and 10 December and three varieties of chickpea *viz*. Vaibhav, JG-14 and JG-16 were laid out in Factorial Randomized Block Design with three replications. Among different sowing dates, 10 November sown crop exhibited more number of Seeds/plant (38.8), higher stover yield (2002.2 kg/ha) followed by 25 November seeds/plant (38.7), stover yield (1828.4) and 10 December pods/plant (28.9), stover yield (1243.1 kg/ha).Among different varieties, JG-16 produced significantly more number of pods/plant (36.6), seeds/plant (45.0), seed yield (1924.3 kg/ha) higher stover yield (1880.3 kg/ha) followed by cv. JG-14 pods/plan (30.5), seed/plant (36.0), seed yield (1465.2 kg/ha), higher stover yield (1490.6 kg/ha) and Vaibhav pods/plant (19.8), seeds/plant (25.2), seed yield (1596.8 kg/ha), higher stover yield (1702.9 kg/ha), JG-14 exhibited higher 100 seed weight (25.2 g) followed by cv. Vaibhav (25.0 g) and both were significantly superior over JG-16 (17.2g).Interaction effect between growing environments and varieties for pods/plant was found significant and cultivar JG-16 exhibited higher number of pods/plant under 25 November (41.3) followed by the same variety sown on 10th November.

Keywords: chickpea, yield attribute, yield, stover yield, seed yield

1. Introduction
Chickpea is considered the third most important pulse in the world after bean and soybean (Soltani, *et al.* 2006) [6]. Chickpea is the common name for an annual plant, *Cicerarietinum*, of the Fabaceae (or Leguminosae) family that is widely cultivated for its typically yellow-brown, pea like seeds. This light brown colored pulse is considered to be a good source of protein. Seed of chickpea are used as edible seed and also used for making flour throughout the globe. Chickpea crop is having a capacity to stand in drought conditions, India is the major chickpea (Gram/Chana) producing country, and chickpea crop is basically grown in the dry regions of India. The major chickpea producing states of India are Madhya Pradesh, followed by Maharashtra, Rajasthan, Uttar Pradesh, Andhra Pradesh and Karnataka (FAO, 2013) [4]. In India, it is grown in about 8.56 million hectares area with the production of 7.35 million tonnes and productivity of 859 kg/ha (Tiwari and Meena, 2014). In Chhattisgarh the area of chickpea in the year 2015-16 is 351.31 thousand/ha and the productivity is 852 kg/ha (Krishi diary, 2016) [5].

There is a growing demand for chickpea due to its nutritional value. India is the largest producer, importer and consumer of pulses in the world. Accounting for 25% of the global production 15% trade and 27% consumption, as sizeable population in the country still depends on vegetarian diets to meet its protein requirement (Ali and Kumar, 2007) [1]. The importance of temperature and humidity in enhancing plant nutrient availability and absorption and also the role they play in disease and pest infestation is well documented. Relationship between two or more weather parameters with grain yield of crops can be used for yield prediction well before the actual harvesting of the crops. The unusual weather during reproductive period of a crop adversely affects the crop productivity. Although the climate is the least manageable part of environmental resources, yet a better understanding of the climatic resources and their interactions with agricultural parameters can help to increase the crop productivity (Goswami *et al.*, 2006) [2].

Sowing time and cultivars are two important factors which can affect the growth and yield of chickpea. The most vital step towards enhancing yield of chickpea is to ensure that the phenology of the crop is well in line to resources and constraints of the production environment. One method to enhance grain yield in chickpea would be to change the sowing time using existing cultivars which are resistant to biotic and abiotic disorders (Rahman, *et al.* 1992) [3].

2. Material and Method

2.1 Experimental site

The field experiment was conducted at the Research and Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya; Raipur situated in South Eastern Central part of Chhattisgarh at latitude, longitude and altitude of $21^0$16' N, longitude $81^0$36' E and 289.5 m above mean sea level, respectively.

2.2 Climate

The climate of Chhattisgarh state is classified as dry sub humid. Nearly 90 % of the annual average rainfall occurs from June to September during south west monsoon. During rabi season the normal maximum temperature ranged between (26.6 ^{0}C to 37.3^{0}C) while minimum temperature ranged between (10.1 to 19.6^{0}C). The morning relative humidity varied from 56 to 90 % whereas, the afternoon humidity varied from 19 to 42 % (45 SMW and 13 SMW).

2.3 Post-harvest observation

2.3.1 No. of pods/plant

Total number of pods was recorded from five randomly tagged plants and mean was worked out by dividing the total number of pods by five and used for statistical analysis.

2.3.2 No. of seeds/plant

Randomly selected five tagged plants from each plot taken for number of pods were threshed and their seeds were counted and it was averaged to get mean number of seeds per plant.

2.3.3 Test weight

After recording the net plot seed yield, seed samples were taken randomly from the produce of each plot. Collected seed samples were oven dried till the weight became constant. Hundred seeds were counted from the oven dried samples of each plot and their weight was recorded by using an electronic balance.

2.3.4 Seed yield

The weight of clean seeds recorded from each net plot at 14% moisture was converted into kg/ha by multiplying with multiplication factor. Seed weight of sample plants was also added to net plot yield before converting into seed yield kg/ha.

2.3.5 Stover yield

Stover yield is obtained by subtracting seed yield (kg/ha) from biological yield (kg/ha)

3. Result and Discussion

In the final analysis at the time of harvest, the yield attributes, seed yield, Stover yield, biological yield and harvest index were recorded. The final yield of any crop species depends on the source and sink relationship and on different components of sink *viz*., number of pod per plant, number of seeds per plant and test weight (100-seed weight). Source components could be the LAI and pre-anthesis assimilate reserves before flowering. Final yield, therefore, is a function of all components of source and sink operating at different pheno phase of growth during life cycle of plant.

The number of pods per plant was realized highest under timely sown chickpea crop on 25 November and 10 November as compared to late sown on 10 December. Variation in sowing time beyond optimum was found to decrease the number of pods per plant and it was also reported earlier by Dixit *et al.* (1993) [7]. However, number of seeds per pod and 100-seed weight among the different growing environments was differing significantly. Similar significant seasonal effects on number of seeds per pod and 100-seed weight was reported by Dumbre and Deshmukh (1983) [8], Chaitanya and Chandrika (2006) [9] and Ahmed *et al*., (2011) [10]. The highest seed yield (kg/ha) were recorded in 25 November sowing followed by 10 November and 10 December.

The higher seed yield (1942.4 kg/ha) produced by 25 November sowing might be attributed to improve yield attributing *i.e*., number of pods per plant. The favorable effect of early sowing (25 November) on sink component could be attributed to better development of the plants in terms of plant height and dry matter production leading to increased bearing capacity due to optimum growth on account of favorable temperatures during early vegetative phase. Pezeshkpur *et al*. (2005) [11] also interpreted that early sowing dates had higher yields of chickpea.

The drastic reduction in the seed yield (1241.3 kg/ha) under 10 December sowing could also be attributed to shortening of reproductive phase caused by forced maturity because of sudden rise in temperature during maturity phase. This resulted in poor number of pods per plant, which ultimately decreased the seed yield (kg/ha). The reduction in seed yield under delayed sowing could also be due to less translocation of current photosynthates towards reproductive parts, rapid initiation of inflorescence, flowering, fruiting and maturity, less number of pods and less pod filling duration because of non-fulfillment of temperature demands under late sowing. High temperatures and long days accelerated rapid maturity and lower the seed yield (Mondal *et al.* 2011) [12]. The biological yield (kg/ha) was also significantly higher in 25 November sowing. The reduction in biological yield under delayed sowing occurred primarily due to the decrease in growth characters in terms of plant height, LAI and lower biomass build up plant The slower growth on account of lower temperature during early vegetative growth phase and the overall shorter life span of crop caused reduction biomass production. The earlier findings of Ahmed *et al*., (2011) [10] corroborate these results.

3.1 Effect of varieties

The cultivar JG-16 produced significantly higher number of pod per plant as compared to *cv*. Vaibhav and JG-14. The differences in yield attributing characters of these varieties could be attributed to their genetic constitution. The differences in yield attributes of different chickpea varieties had been well documented by Chaitanya and Chandrika (2006) [9] and Sardar (2009) [13], The cultivar JG-16 produced significantly higher seed yield (1924.3 kg/ha). The higher seed yield in *cv*. JG-16 might be due to more number of pods per plant. This was in agreement with Shiva Kumar (2001) [14]. The lower seed yield (kg/ha) in *cv*. JG14 might be due to less number of pods per plant. The varietal differences in seed yield of chickpea had also been reported by Chaitanya and Chandrika (2006) [9] and Shamsi (2010) [15]. The significant

behavior of varieties in relation to seed yield (kg/ha) could also be attributed to the differential trend in respect of biomass partitioning towards reproductive parts. Another probable reason for the significant difference in seed yield (kg/ha) among the varieties could be due to fact that the varieties have different compensation mechanisms which affect the seed yield.

3.2 Number of pods/plant

Number of pods per plant have been analyzed for different growing environments and varieties. This parameter is a crucial parameter and directly contributing for seed yield and stover yield. It has been found that number of pods are significantly higher in second growing environment i.e. normal sowing. However, the first and second growing environments are found to be statistically at par to each other. Third growing environment is found to under-perform and it is found statistically far below the other two growing environments. As far as varieties are concerned, JG-16 variety is found to perform outstanding well and it is statistically far ahead than the varieties JG-14 and Vaibhav. Zonal check JG-14 is also performing well but is statistically below JG-16. Vaibhav variety is found to have the least number of pods per plant.

The number of pods per plant as influenced by various treatments are shown in table 3.2. The data revealed that dates of sowing was significantly influenced the number of pods per plant. The highest number of pods per plant was recorded with 25 November D_2 sowing (32.3) followed by 10 November (D_1) sowing (32.1) and lowest was under 10 December (D_3) sowing (22.5).

As for as number of pods per plant for varieties is concerned it was significant at 5% level of significance and ranges from 36.6 (JG-16 number of pods per plant) to 19.8 (Vaibhav number of pods per plant). The interaction between varieties and dates of sowing was found significant. JG-16 number of pods per plant recorded highest over under suitable growing environments.

Table 1: Number of pods/plant at harvest as affected by growing environment for chickpea varieties

Varieties	D1 (10-11-17)	D2 (25-11-17)	D3 (10-12-17)	Mean
V1-Vaibhav	23.0	20.7	15.9	19.8
V2-JG-14	33.4	35.0	23.1	30.5
V3-JG-16	39.9	41.3	28.5	36.6
Mean	32.1	32.3	22.5	29
	SEm +	CD(P=0.05)	CV (%)	
Date	0.50	1.50	5.18	
Variety	0.50	1.50		
DXV	0.87	2.60		

3.3 Number of seeds/ plant

The number of seeds per plant as influenced by various treatments are shown in table 3.3. The data revealed that dates of sowing was significantly influenced the number of seeds per plant. The highest number of seeds per plant was recorded with 10 November D_1 sowing (38.8) followed by 25 November (D_2) sowing (38.7) and lowest was under 10 December (D_3) sowing (28.9).

As for as number of seeds per plant for varieties is concerned it was significant at 5% level of significance and ranges from 45.0 (JG-14 number of seeds per plant) to 25.2 (Vaibhav number of seeds per plant). The interaction between varieties and dates of sowing was found significant. JG-16 number of seeds per plant recorded highest over under suitable growing environments

Table 2: Number of seeds/plant at harvest stages as affected by growing environment for chickpea varieties

Varieties	D1 (10 -11-17)	D2 (25-11-17)	D3 (10-12-17)	Mean
V1Vaibhav	28.5	26.1	21.1	25.2
V2-JG-14	39.1	39.9	29.1	36.0
V3-JG-16	48.8	50.0	36.3	45.0
Mean	38.8	38.7	28.9	35
	SEm +	CD (P=0.05)	CV (%)	
Date	0.55	1.65	4.67	
Variety	0.55	1.65		
DXV	0.96	2.86		

3.4 Test weight (g)

It can be very well seen that 100 seed weight is not affected by growing environment. However the highest test weight has been observed under normal sowing of 25 November. There are significant varietal differences, the highest test weight has been found in Vaibhav variety and it is being followed by zonal check variety JG-14.

The data pertaining to 100 seed weight (seed index) as influenced by growing environments and varieties are presented in Table 3.4.

The data on test weight of chickpea recorded as influenced by various treatment are presented in the table 4.14. Different growing environments non significantly influence the test weight. The highest test weight recorded under 25 November (D_2) sowing (23.1 g) followed by 10 November (D_1) sowing (22.4 g) and lowest was found under 10 December (D_3) sowing (21.9 g).

The test weight which happens to be genetic parameter was significantly influenced by different varieties and highest test weight was obtained with (V2) JG-14 (25.2 g) followed by (V1) Vaibhav (25.0 g) and both were significantly differs. The lowest test weight was observed with (V3) JG-16 (17.2 g). Interaction between varieties and dates of sowing was found non-significant at 5% level of significance.

Table 3: Test weight (g) (100 seeds) as affected by growing environment for chickpea varieties

Varieties	D1 (10 -11-17)	D2 (25-11-17)	D3 (10-12-17)	Mean
V1-Vaibhav	26.3	26.0	22.7	25.0
V2-JG-14	24.3	25.7	25.7	25.2
V3-JG-16	16.7	17.7	17.3	17.2
Mean	22.4	23.1	21.9	22
	SEm +	CD (P=0.05)	CV (%)	
Date	0.51	NS	6.75	
Variety	0.51	1.52		
DXV	0.88	NS		

3.5 Seed yield (kg/ha)

Working on the similar lines, grain yield has been calculated and it has been found that grain yield is highest in normal date sowing D_2 and it is found on the expected lines. It can be observed that though the grain yields are statistically at par in first two growing environments D_1 and D_2 but yield drastically decreases in D_3. The possible reason for this is that crop is suffering from thermal stress condition in late stage of development cycle of the crop. Varietal differences in grain yield have also been observed and variety JG-16 has been found to be the highest yielder. There are two bold seed

varieties viz., Vaibhav and Zonal check variety JG-14 and these are found statistically at par in terms of seed yield.

The data on seed yield of varieties as affected by different growing environments are presented in the table 3.5. The seed yield was significantly influenced by different growing environments. The significantly highest seed yield was recorded for crop sown on D2 25 November (1942.4 kg/ha) followed by D1 10 November (1802.5 kg/ha) and the lowest seed yield was observed when crop was sown on D3 10 December (1241.3 kg/ha).

Similarly variety significantly the highest seed yield was recorded with (V3) JG-16 (1924.3 kg/ha) followed by (V1) Vaibhav (1596.8 kg/ha) and lowest seed yield was recorded under (V2) JG-14 (1465.2 kg/ha). The interaction between dates of sowing and varieties was found non-significant at 5% level of significance.

Table 4: Seed yield (kg/ha) as affected by growing environment for chickpea varieties

Varieties	D1(10 -11-17)	D2(25-11-17)	D3(10-12-17)	Mean
V1-Vaibhav	1756.7	1864.0	1169.7	1596.8
V2-JG-14	1467.5	1782.3	1145.7	1465.2
V3-JG-16	2183.3	2181.0	1408.7	1924.3
Mean	1802.5	1942.4	1241.3	1662
	SEm ±	CD (P=0.05)	CV (%)	
Date	73.80	221.24	13.32	
Variety	73.80	221.24		
DXV	127.83	NS		

3.6 Stover yield (kg/ha)

The data on stover yield as affected by different treatments is given in the Table 3.6. The stover yield (kg/ha) under different growing environments was found significant and ranges from 1243.1 (kg/ha) to 2002.2 (kg/ha). The highest stover yield was obtained when crop was sown on 10 November (D1) which is significantly higher over D2 (25 November) and D3 (10 December). Similarly the highest stover yield was observed in variety JG-16 (V3) (1880.3 kg/ha) followed by Vaibhav (V1) (1702.9 kg/ha) which were at par with each other but non significantly differed from rest of the varieties. Variety JG-14 (V2) recorded non Significantly stover yield over other varieties. The interaction between varieties and growing environments showed the non-significant difference at 5% level of significance.

Table 5: Stover yield (kg/ha) as affected by growing environment for chickpea varieties

Varieties	D1(10 -11-17)	D2(25-11-17)	D3(10-12-17)	Mean
V1-Vaibhav	1894.1	1959.9	1254.7	1702.9
V2-JG-14	1735.9	1608.5	1127.3	1490.6
V3-JG-16	2376.6	1916.9	1347.3	1880.3
Mean	2002.2	1828.4	1243.1	1691.2
	SEm ±	CD (P=0.05)	CV (%)	
Date	110.5	331.21	19.60	
Variety	110.5	NS		
DXV	191.4	NS		

4. Conclusion

Among different sowing dates, 25 November sown crop exhibited significantly more number of pods plant-1 (32.3) followed by 10 November (32.1) and 10 December (22.5) sown crops and different varieties, JG-16 produced significantly more number of pods plant-1 (36.6) followed by cv. JG-14 (30.5) and Vaibhav (19.8) sown crops. Interaction effect between sowing dates x varieties for pods (plant-1) was found significant. Cultivar JG-16 exhibited significantly higher number of pods (plant-1) under 25 November (41.3) sown crop followed by sown under 10 December (15.9) dates. Among different growing environments it is clear from the data that 100 seeds weight differ significantly. However, numerical value was recorded higher in 25 November (23.1 g) sowing followed by 10 November (22.4 g) and 10 December (21.9 g) sown crops. Among different varieties, JG-14 exhibited significantly higher 100 seed weight (25.2 g) followed by cv. Vaibhav (25.0 g) and JG-16 (17.2g).

5. References

1. Ali M, Kumar S. Pluses Good option for rain fed areas, The Hindu Survey of Indian Agriculture. 2007, 39-41.
2. Goswami B, Mahi GS, Saikia US. Effect of few important climatic factors on phenology, growth and yield of rice and wheat.Ludhiana-141004, Indian j of Agro met. 2006; 27(3):223-228
3. Rahman MM, Miah AA, Hamid A, Maniruzzaman AFM. Growth analysis of chickpea genotypes in relation to grain filling period and yield potential. Bangladesh Journal of Botany. 1992; 21(2):225-231.
4. FAO. Food and agricultural commodities production. Food and Agriculture Organization of the United Nations, 2013, 53.
5. Krishi Diary Indira Gandhi Krishi Vishwavidyaiaya, Raipur, C.G. 2016, 5-6.
6. Soltani A, Hammer GL, Torabi B. Modeling chickpea growth and phenological development. *Field Crop Res*. 2006; 24(3):1-13.
7. Dixit JP, Pillai PVA, Namdeo KN. Response of chickpea (*Cicer arietinum*) to planting date and irrigation schedule. Indian J of Agron. 1993; 38:121-123.
8. Dumbre AD, Deshmukh RB. Yield of gram varieties as affected by sowing dates, fertilizer application and irrigation. J Maharashtra Agric. Univ. 1983; 8:300-303.
9. Chaitanya SK, Chandrika. Response of chickpea genotype to different date of sowing in alligols of chittor district. Andhra Pradesh, India. Int. chickpea and pigeonpea Newsletter. 2006; 10:8-9.
10. Ahmed F, Islam MN, Jahan MA, Rahman MT, Ali MZ. Phenology, growth and yield of chickpea as influenced by weather variables under different sowing dates. J Exptl. Biol. 2011; 2(2):83-88.
11. Pezeshkpur P, Ahmadifar A, Daneshvar M. The effect of planting date on grain yield and its components, leaf chlorophyll index, and light penetration rate to vegetative shading floor. In proceeding of the national conference on pulse in Iran. 20-21 November 2005. Research Center for Plant Sciences, Ferdowsi university of Mashhad, Mashhad. Iran, 2005.
12. Mondal MRI, Begum F, Saiyed IM. Effect of planting dates on seed and oil yield of rapeseed (*Brassica campestries* L.) genotype BCYS-03. SAARC J Agric. 2011; 9(1):85-93.
13. Sardar RG. Performance of chickpea (*Cicer arietinum* L.) genotypes for green purpose to dates of sowing in northern transition zone of Karnataka. M.Sc. Thesis. Dharwad Uni. Agric. Sci. Dharwad (Karnataka), 2009.
14. Shiva Kumar BG. Indian J Agron. 2001; 29:331-334.
15. Shamsi K. The effect of sowing date and row spacing on yield and yield components on Hashem chickpea variety under rainfed condition. African. J Biotechnology. 2010; 9(1):7-11.