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# Effect of changing environment on growth and yield of chickpea (*Cicer arietinum* L.)

**Ajeet Kumar, SR Mishra, AK Singh, RK Aryan and Anil Nishad**

**Abstract**
A field experiment was conducted during *rabi season* of 2016 on the topic entitled "Study the crop-weather interaction on chickpea (*Cicer arietinum* L.) Cultivars" in sandy loam soil of N.D. University of Agriculture and Technology, Kumarganj, Faizabad (U.P). The experimental consisted of nine treatment combinations comprised of three growing environment *viz.*, sowing on Oct.25$^{th}$ with temperature 24.2 $^0$C, Nov.4$^{th}$ with temperature 22.5 $^0$C and Nov.14$^{th}$ with temperature 22.2 $^0$C and three varieties viz. Radhey, Pusa-372, and BG-256. Results revealed that plant height Taller plants were obtained at sowing temperature 32.5 $^0$C (exist on October 25$^{th}$) which was significant higher over rest sowing dates. Shorter plants were recorded under sowing date November 14$^{th}$. higher leaf area index was obtained at sowing temperature 32.5 $^0$C (existed on Oct.25$^{th}$) as compared to sowing done on Nov.4$^{th}$ and Nov.14$^{th}$ in which later sown i.e. Nov.14$^{th}$ proved lowest LAI at all the stages of crop. Higher leaf area index was obtained in Radhey followed by BG-256 while significantly superior over Pusa-372 cultivar at all the successive stages of chickpea. Maximum plant population (32plant m$^{-2}$) was recorded under sowing done on Oct.25$^{th}$ with sowing temp. 32.5 $^0$C followed by Nov.4$^{th}$ sowing of chickpea. Delay in sowing recorded lowest no. of initial plant population of chickpea Radhey cultivar exhibited maximum initial plant population (32) followed by Pusa-372 (30). Number of branches plant$^{-1}$ shows that different growing environment had significant influence on the number of branches plant$^{-1}$ at all the stages. Crop sown on Oct.25$^{th}$ with temperature 32.5 $^0$C produced significantly higher number of branches plant$^{-1}$ was significantly superior over both sowing done on Nov.4$^{th}$ with temperature 30.5 $^0$C and Nov.14$^{th}$ with temperature 31 $^0$C. Number of branches plant$^{-1}$ was affected significantly by varieties at all the stages.

**Keywords:** chickpea, plant height, LAI, number of branches/plant, initial plant population

## Introduction
Chickpea (*Cicer arietinum* L.) is one of most important pulse crop of India. Chickpea probably originated in south-eastern Turkey and spread west and south via the silk route. Four centres of diversity have been identified in the Mediterranean, Central Asia, near East Asia and India, as well as a secondary centre of originated Ethiopia. It is the world third most important food legume and India is placed first in production. India is the largest producer of chickpea in the world covering 8.25 million hectare area and producing 7.33 million tonne of grain with an average productivity of 889 kg h$^{-1}$ in year 2014-15 (Anonymous, 2016). In Uttar Pradesh, chickpea is cultivated on an area of 0.58 Million hectares in India 5.64% with an annual production of 0.48 Million tonne, in India 4.81% the average productivity of this crop in U.P is only 12.12q ha$^{-1}$. Yield 824 kg/hectare annual report (2014-15). Sowing date and temperature have been proved to be one of the most non-monetary inputs affecting the yield of chickpea. Sub optimal thermal regimes during crop growing season are known to have profound effect on crop productivity. The production potential of high productive varieties may be exploited by sowing them at their most optimum time. Chickpea cultivated with medium and long duration varieties is generally delayed. All the chickpea varieties are sensitive to photo and thermal-period. Delay in sowing causes early maturity of the cultivars resulting in drastic reduction of the yield. Optimum sowing time is considered for maximum advantages of environmental condition, especially in the terms of the thermal requirement by the crop canopy. The productivity of chickpea in eastern U.P. is quite below than the national average due to which suitable varieties will therefore, be quite helpful in increasing the yield (Shendge *et al.*, 2002) [4].

## Materials and Methods
The present investigation entitled "Study the crop weather interaction on chickpea (*Cicer arietinum* L.)" was carried out during *Rabi* season of 2016-2017 at Student Instructional Farm

of N.D. University of Agriculture and technology Kumarganj, Faizabad (U.P.). The experiment was conducted in split plot design with three growing environment *viz*. October 25th with sowing temperature 32.5$^0$C ($D_1$); November 4th with sowing temperature 30.5$^0$C ($D_2$); November 14th with sowing temperature 31$^0$C ($D_3$) and three cultivars *viz*. Radhey ($V_1$), Pusa-372 ($V_2$), BG-256 ($V_3$). The experiment was replicated four times. The different growth parameters studied were chickpea as plant height, LAI, no. of branches /plant, initial plant population.

**Result**

Data pertaining to plant height of chickpea recorded at various growth stages as affected by growing environment and cultivars have been presented in table - 1. Plant height increased successively with age of crop. It is evident from the data that date of growing environment influenced plant height significantly at all the growth stages. Taller plants were obtained at sowing temperature 32.5 $^0$C (exist on October 25th) which was significant over rest both of the sowing dates. Shorter plants were recorded under delayed sowing. Cultivars had significant variation on plant height at all the stages, except 30 DAS. It is quite evident from the data that higher plant height was obtained in Radhey which was at par with Pusa-372 at all the stages while significantly superior over BG-256 cultivar. Data also showed that BG-256 cultivar recorded smaller height of plant at all the stages, except 30 DAS. Data pertaining to leaf area index as affected by growing environment have been presented in table -2. LAI increased successive up to 105 DAS and there after declined. It is quite obvious from the data that the LAI was significantly affect due to growing environment at all the stages. Significantly higher leaf area index was obtained at sowing temperature 32.5 $^0$C (existed on Oct.25th ) as compared to sowing done on Nov.4th and Nov.14th in which later sown i.e. Nov.14th proved lowest LAI at all the stages of crop.

Data pertaining to number of branches plant$^{-1}$ as affected by different treatments are given in table -3. It is quite evident from the data that different growing environment had significant influence on the number of branches/ plant at all the stages of the observation. A cursory glance over data quite revealed that crop sown on Oct.25th with temperature 32.5$^0$C produced significantly higher number of branches plant$^{-1}$ was significantly superior over both sowing done on Nov.04th with temperature 30.5 $^0$C and Nov. 14th with temperature 31$^0$C. Maximum number of braches plant$^{-1}$ is recoded with Oct 25th with temperature 32.5 $^0$C and minimum number of braches plant$^{-1}$ is recorded with Nov.14th with temperature 31 $^0$C at all the stages of the observation. The number of branches plant$^{-1}$ was affected significantly by cultivars at all the stages. The higher number of branches was recorded with Avarodhi which was at par with PG-186 cultivar and significantly superior over Uday at all the stages of the observation. Minimum number of braches plant$^{-1}$ was recoded with Uday all the growth stages of the observation.

Data pertaining to initial plant population recorded at 15 DAS as influenced by growing environment and cultivars have been presented in table- 4. Maximum plant population (32 m$^{-2}$) was recorded under sowing done on Oct.25th with sowing temp. 32.5$^0$C followed by Nov. 4th sowing of chickpea. Delay in sowing recorded lowest no. of initial plant population of chickpea. It is evident from the data that Radhey cultivar exhibited maximum initial plant population (32) followed by Pusa-372.

**Table 1:** Plant height as affected by different growing environment

| Treatments | Initial plant population | Plant height(cm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30 DAS | 45 DAS | 60 DAS | 75 DAS | 90 DAS | 105 DAS | 120 DAS | At harvest |
| **Growing environment** | | | | | | | | | |
| Oct.25/32.5 $^0$C | 32 | 17.5 | 20.5 | 27.1 | 31.6 | 38.2 | 44.6 | 50.2 | 50.7 |
| Nov.4/30.5 $^0$C | 30 | 16.8 | 19.2 | 25.3 | 29.6 | 35.6 | 41.6 | 46.9 | 47.4 |
| Nov.14/31 $^0$C | 28 | 16.1 | 18.4 | 24.3 | 28.4 | 34.2 | 39.9 | 45.0 | 45.5 |
| SEm± | 0.75 | 0.48 | 0.38 | 0.46 | 0.72 | 0.69 | 0.90 | 1.05 | 1.09 |
| CD at 5% | 2.61 | 1.6 | 1.33 | 1.61 | 2.51 | 2.39 | 3.12 | 3.63 | 3.45 |
| **Cultivars** | | | | | | | | | |
| Radhey | 30 | 17.3 | 20.3 | 26.9 | 31.3 | 37.8 | 44.1 | 49.7 | 50.3 |
| Pusa-372 | 30 | 16.6 | 19.0 | 25.1 | 29.3 | 35.3 | 41.2 | 46.4 | 46.9 |
| BG-256 | 30 | 16.4 | 18.8 | 24.8 | 29.0 | 34.9 | 40.8 | 46.0 | 46.4 |
| SEm± | 0.64 | NS | 0.29 | 0.45 | 0.58 | 0.65 | 0.84 | 0.94 | 0.95 |
| CD at 5% | 1.9 | 0.96 | 0.88 | 1.35 | 1.73 | 1.95 | 2.52 | 2.81 | 2.77 |

**Table 2:** Leaf area index of chickpea as affected by growing environment and cultivars

| Treatments | Leaf area index | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 DAS | 45 DAS | 60 DAS | 75 DAS | 90 DAS | 105 DAS | 120 DAS |
| **Growing environment** | | | | | | | |
| Oct.25/32.5 $^0$C | 0.24 | 0.58 | 1.83 | 2.20 | 2.73 | 2.89 | 2.75 |
| Nov.4/30.5 $^0$C | 0.23 | 0.54 | 1.71 | 2.06 | 2.55 | 2.70 | 2.57 |
| Nov.14/31 $^0$C | 0.22 | 0.52 | 1.64 | 1.98 | 2.45 | 2.59 | 2.46 |
| SEm± | 0.007 | 0.010 | 0.040 | 0.051 | 0.060 | 0.058 | 0.063 |
| CD at 5% | 0.021 | 0.030 | 0.127 | 0.160 | 0.189 | 0.184 | 0.200 |
| **Cultivars** | | | | | | | |
| Radhey | 0.23 | 0.57 | 1.81 | 2.18 | 2.70 | 2.86 | 2.72 |
| Pusa-372 | 0.23 | 0.53 | 1.69 | 2.04 | 2.52 | 2.67 | 2.54 |
| BG-256 | 0.22 | 0.53 | 1.67 | 2.02 | 2.50 | 2.64 | 2.52 |
| SEm± | 0.004 | 0.011 | 0.036 | 0.042 | 0.053 | 0.055 | 0.055 |
| CD at 5% | 0.013 | 0.032 | 0.106 | 0.122 | 0.155 | 0.160 | 0.161 |

**Table 3:** Number of primary branches plant$^{-1}$ of chickpea as affected by growing environment and cultivars

| Treatments | Number of primary branches plant$^{-1}$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 DAS | 45 DAS | 60 DAS | 75 DAS | 90 DAS | 105 DAS | 120 DAS |
| **Growing environment** | | | | | | | |
| Oct.25/32.5$^0$C | 3.2 | 6.0 | 6.5 | 7.2 | 8.1 | 8.9 | 10.3 |
| Nov.4/30.5 $^0$C | 3.1 | 5.6 | 6.0 | 6.7 | 7.6 | 8.3 | 9.7 |
| Nov.14/31 $^0$C | 3.0 | 5.4 | 5.8 | 6.4 | 7.3 | 7.9 | 9.3 |
| SEm± | 0.09 | 0.11 | 0.11 | 0.16 | 0.14 | 0.19 | 0.22 |
| CD at 5% | NS | 0.39 | 0.38 | 0.57 | 0.51 | 0.68 | 0.79 |
| **Cultivars** | | | | | | | |
| Radhey | 3.2 | 6.0 | 6.4 | 7.1 | 8.1 | 8.8 | 10.2 |
| Pusa-372 | 3.1 | 5.6 | 6.0 | 6.6 | 7.5 | 8.2 | 9.6 |
| BG-256 | 3.1 | 5.5 | 5.9 | 6.6 | 7.4 | 8.1 | 9.5 |
| SEm± | 0.06 | 0.08 | 0.10 | 0.13 | 0.14 | 0.16 | 0.20 |
| CD at 5% | NS | 0.26 | 0.32 | 0.39 | 0.42 | 0.49 | 0.60 |

**Table 4:** Initial Plant population as affected by growing environment cultivars of chickpea

| Treatments | Plant population (m$^{-2}$) at 15 DAS |
|---|---|
| **Growing environment** | |
| Oct. 25/32.5$^0$C | 32 |
| Nov. 4/ 30.5$^0$C | 30 |
| Nov. 14/ 31$^0$C | 28 |
| **Cultivars** | |
| Radhey | 30 |
| Pusa-372 | 30 |
| BG-256 | 30 |

## Conclusions

It is concluded that study in highest Plant height increased successively with age of crop. Growing environment influenced plant height significantly at all the growth stages. Taller plants were obtained at sowing temperature 32.5 $^0$C (exist on October 25$^{th}$) which was significant higher over rest sowing dates. Shorter plants were recorded under sowing date November 14$^{th}$. Higher plant height was obtained in Radhey which was at par with BG-256 at all the stages while significantly superior over Pusa-372 cultivar. Pusa-372 cultivar recorded smaller height of Plant at all the stages. LAI was significantly affected due to growing environment at all the stages. Significantly higher leaf area index was obtained at sowing temperature 32.5$^0$C (existed on Oct.25$^{th}$) as compared to sowing done on Nov.4$^{th}$ and Nov.14$^{th}$ in which later sown i.e. Nov.14$^{th}$ proved lowest LAI at all the stages of crop. Higher leaf area index was obtained in Radhey followed by BG-256 while significantly superior over Pusa-372 cultivar at all the successive stages of chickpea. Maximum plant population (32plant m$^{-2}$) was recorded under sowing done on Oct.25$^{th}$ with sowing temp. 32.5 $^0$C followed by Nov.4$^{th}$ sowing of chickpea. Delay in sowing recorded lowest no. of initial plant population of chickpea Radhey cultivar exhibited maximum initial plant population (32) followed by Pusa-372 (30). Number of branches plant$^{-1}$ shows that different growing environment had significant influence on the number of branches plant$^{-1}$ at all the stages. Crop sown on Oct.25$^{th}$ with temperature 32.5 $^0$C produced significantly higher number of branches plant$^{-1}$ was significantly superior over both sowing done on Nov.4$^{th}$ with temperature 30.5 $^0$C and Nov.14$^{th}$ with temperature 31 $^0$C. Number of branches plant$^{-1}$ was affected significantly by varieties at all the stages. The higher number of branches was recorded with Radhey followed by BG-256 cultivar which was significantly superior over Pusa-256 at all the stages.

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