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The optimize congenial climatic condition to harvest the optimum Yields of chickpea under prevailing weather condition.

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ABSTRACT
A field experiment was conducted during rabi season of 2016-17 at Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut (U.P.) The experimental consisted of nine treatment combinations comprised of three sowing date/ sowing temperature viz., sowing on Oct. 17th with temperature 27.8 0C, Oct. 27th with temperature 24.2 0Cand Nov.6th with temperature 19.5 0C and three varieties viz., Desi, Kabuli, and PG-186. Results revealed that sowing temperature 27.8 0C which occurred on Oct. 17th produced significantly higher growth yield attributes and yield due to fulfilment of optimum thermal requirement for various plant processes. High temperature during-reproductive stage adversely affected the number of pods plant-1 number of seed pod-1 in late sowing (Nov.6th) which ultimately result the lowest seed yield. Delay in sowing reduced the average temperature during the crop period and Grain yield. Decreases in average in Nov.6th by 6.20C reduced the grain yield by6.0 qha-1 over Oct. 17th sowing. Heat use efficiency was recorded when sowing was done sown Oct 17st with temperature 27.8 0C followed by sowing done on Oct. 27th while lowest heat use efficiency was recorded when sowing was done on Nov.6th with sowing temperature 190 C. Desi variety was found more conducive for growth development grain yield and heat use efficiency.

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a major food legume grown by the poor and subsistence farmers in semi-arid tropics (SAT) of Asia and Africa. It is grown in over 50 countries of Asia, Africa, America, and Oceania in rain- fed environments. The annual production of chickpea is 11.3 million tons. 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 11.3 million hectare area and producing 9.78 million tonnes of grain with an average productivity of 1029 kg h^{-1}. In Uttar Pradesh, chickpea is cultivated on an area of 7.2 lakh hectares with an annual production of 8.73 lakh tons, the average productivity of this crop in U.P is only 13.07q ha^{-1}. Thus, the average productivity of chickpea in U.P is very low as compared to other states like Bihar and Punjab. Chickpea is grown in India as post monsoon winter season (*Rabi*) crop as it requires cool and dry weather for optimum growth. The crop is predominantly grown under rain-fed condition and is raised mainly on conserved soil moisture optimum sowing temperature and selection of improved cultivars play an important role in exploiting the yield potential of crop under particular agro-climatic conditions. It is well suited to dry land or limited-irrigation production. Sowing date and temperature have been proved to be one of the most non-monetary inputs affecting the yield of chickpea. Chickpea performs well when planted on well-drained soils of near neutral pH. Chickpea grows best when day time temperature are 70-85 ^{0}F and night-time temperature are near 65^{0}F. The time of maturity depends on type and variety and ranges from 95 to 110 days. 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).

MATERIALS AND METHODS

The field experiment was carried out during *rabi* season of 2016-2017 at Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut (28°98′ N latitude, 77°70′ E longitude. Meerut district enjoys sub-humid climate and received average annual rainfall about 845 mm. The minimum and maximum temperature during the years have tendency to increase from February onwards to June and decreases from July to December and later drops rapidly with minimum value in the month of January. May is the hottest month of the years (Tripathi et al. 1998). The experiment was laid out in split plot Design (SPD). Nine treatment combinations comprised of three sowing date/sowing temperature *viz.,* October. 17st sowing temperature 27.8°C (D_1), October. 27th /sowing temperature 24.2°C (D_2), Nov.6th /sowing temperature 19.5°C (D_3) was kept in main plot and three varieties *viz.,* Desi (V_1), Kabuli (V_2), and PG-186 (V_3) was kept as sub plot treatment. Sowing was done as per treatment in rows 30 cm apart opened with the help of Kudal. Seed were drilled in furrows and covered manually just after sowing. Recommended dose of fertilizer nitrogen, phosphorus and potassium was applied at the rate of 20, 40 and 0 kg ha^{-1} respectively. The whole quantity of nitrogen was applied as basal dose at the time of sowing in the crop. All other agronomic and plant protection measures were applied as per recommendation. Total dry matter accumulation (gm^{-2}) was recorded at 30, 45, 60, 75, 90,105, 120 DAS and at physiological maturity. Yield attributes recorded from the five plants sample collected at the time of harvest. The crop harvested from net plot area was converted into seed yield (kg ha^{-1}).

RESULTS AND DISCUSSION

Dry matter accumulation

Total dry matter accumulation (g m^{-2}) varied significantly due to different growing environments at all the phenophases. (Table-`1). It is quite obvious from the data that dry matter accumulation varied significantly due to date of sowing/sowing temperature at all the stages of chickpea. It was recorded higher under the treatment when chickpea was sown on Oct. 17th with sowing temperature 27.8 ^{0}C which was at while significantly superior followed by sowing on Oct. 27th and November 6th. Dry matter accumulation was affected significantly at all the stages due to varieties table 1. Highest dry matter accumulation was recorded in Desi variety which was at par with PG-186 while significant with Kabuli at all the stages of chickpea. Data also reveal that Kabuli variety recorded lowest dry matter accumulation at all the growth stages.

Radiation use efficiency

The data pertaining to Radiation use efficiency as affected by sowing dates/sowing temperature and varieties are given in table 2. Results indicated that Radiation use efficiency increased successively till 90 days after sowing and thereafter gradually declined irrespective of treatments. Chickpea sown on Oct. 17th recorded higher Radiation use efficiency during all the stages followed by Oct. 27th sowing and lowest in Radiation use efficiency was recorded in Nov.6th sown of Chickpea Different varieties had significant variation on Radiation use efficiency (RUE) as given in table 2. Higher radiation use efficiency was recorded under Desi followed by PG-186 at all the stages of chickpea while the lowest RUE was recorded in Kabuli varieties.

Yield attributing characters and yields

Yield attributing and yields were significantly influenced due to different crop growing environments table 3. The crop sown on Oct 17st with sowing temperature 27.8^{0}C which was significantly more number of pod (plant^{-1}), higher seed yield (kg ha^{-1}) and biological yield (kg ha^{-1}) as compared to Oct 27th with sowing temperature 24.2^{0}C and Nov. 6th sowing with sowing temperature 19.5 ^{0}C. However, sowing dates were failed to influence the more number of seeds (pod^{-1}) and 100-seeds weight. The maximum temperature during reproductive phase had negative correlation with number in temperature from 27.8 ^{0}C (Oct 17st) to 24.2^{0}C (Oct 27th) and 19.5 ^{0}C (Nov. 6th). These results corroborate the findings of Tyagi (2014).

Among cultivars, Desi exhibited significantly more number of pod (plant^{-1}), higher seed yield (kg ha^{-1}) and biological yield (kg ha^{-1}) followed by Kabuli and PG-186. Varieties were failed to influence the number of seeds (pod^{-1}) significantly. The varietial differences for yield attributes and yield in chickpea was also reported by Singh et al. (2012).

Table 1 Dry matter accumulation (gm^{-2}) of chickpea as influenced by various treatments

Treatments	DAS							
	30	45	60	75	90	105	120	A.H
Date of sowing/sowing temp.								
Oct.17/27.8 ^{0}C	135.6	256.1	332.1	411.5	542.2	624.7	685.9	802.5
Oct. 27/24.2 ^{0}C	126.4	239.9	311.4	382.9	505.3	591.8	647.7	757.8

Nov.6/19.5 ^{0}C	123.4	208.6	277.8	338.6	449.1	496.3	612.2	716.3
SEm±	4.2	6.7	8.0	11.2	16.5	16.4	16.0	17.6
CD at 5%	NS	23.4	28.0	38.9	57.4	56.8	55.4	61.0
Varieties								
Desi	132.9	254.7	334.0	409.9	539.3	622.5	684.1	800.4
Kabuli	124.7	210.7	376.3	340.7	453.3	613.9	614.4	718.9
PG-186	127.9	239.2	311.1	382.3	503.9	576.4	647.3	757.3
SEm±	2.7	4.6	5.9	7.8	10.6	11.2	11.1	10.4
CD at 5%	NS	13.6	17.7	23.3	31.7	33.4	32.9	30.9

Table 2 Radiation use efficiency (g/MJ) of chickpea affected by various treatments

Treatments	DAS						
	30	45	60	75	90	105	120
Date of sowing/sowing temp.							
Oct.17/27.8 ^{0}C	0.98	1.13	1.23	1.24	1.62	1.51	1.42
Oct/24.2 ^{0}C	0.94	1.10	1.15	1.25	1.43	1.47	1.34
Nov.6/19.5 ^{0}C	0.87	1.07	1.07	1.20	1.45	1.38	1.33
Varieties							
Desi	0.96	1.13	1.21	1.27	1.55	1.35	1.28
Kabuli	0.93	1.05	1.11	1.23	1.46	1.31	1.24
PG-186	0.95	1.07	1.15	1.24	1.47	1.32	1.25

Table-3 : Yield attributes and yields of chickpea as affected by various treatments

Treatments	No. of Pods Plants^{-1}	Seed weight (g)	No. of Seeds Pod^{-1}	Grain yield (q ha^{-1})	Biological yield (q ha^{-1})
Date of sowing/sowing temp.					
Oct.17/27.8 ^{0}C	86.0	26.1	1.8	24.7	41.0
Oct 27/24.2 ^{0}C	79.3	24.7	1.7	21.9	39.1
Nov.6/19.5 ^{0}C	66.8	23.9	1.5	18.7	34.1
SEm±	2.5	0.18	0.04	0.72	1.32
CD at 5%	8.1	0.58	0.14	2.28	4.16
Varieties					
Desi	84.1	24.4	1.8	24.3	42.2
Kabuli	67.3	24.0	1.6	19.9	34.9
PG-186	80.7	26.2	1.7	21.1	37.2
SEm±	1.68	0.32	0.03	0.47	0.82
CD at 5%	4.92	0.94	0.09	1.39	2.40

CONCLUSION

On the basis of summarized results it may be concluded that : Delay in sowing(on Nov.6th) reduced vegetative phase by 15 days over Oct. 17th sowing and 6 days over Oct. 27th sowing .While from sowing to pod maturity reduced the duration by 19 days over Oct. 17th and 12 days over Oct. 27th owing. Oct. 17th sown crop with sowing temperature 27.8^{0}C produced significantly yield attributes and yield due to fulfilment of optimum thermal requirement at various phenophases of chickpea. High temperature during reproductive stage adversely affected the different yield attributes in delayed sowing (Nov. 6th) which result significantly lowest yield of chickpea. Desi variety was found more conducive for growth, development and yield under different growing environments of chickpea.

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