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POD DEVELOPMENT IN DIFFERENT CHICKPEA (*CICER ARIETINUM* L.) GENOTYPES FOR LATE SOWN HIGH TEMPERATURE CONDITIONS

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Abstract

Field experiment was conducted to investigate the pod development in different chickpea (*Cicer arietinum* L.) genotypes for late sown high temperature conditions of Kymore plateau zone of Madhya Pradesh, India. The sowing time may vary in different locations depending on the temperature experienced at different stages of crop development. It is well adapted within temperature range of 30/15^{0}C (day maximum and night minimum) for optimum growth and pod filling. The crop often experiences abnormally high temperature (>35^0 C) and atmospheric heat stress during reproductive stage. The experiment with 2 sowing dates *viz*., 22nd November, 9th June vary and 31 promising genotypes of chickpea was conducted in Randomized Block Design with three replications. Highest total number of pods plant^{-1} (162.00), fertile pods plant^{-1} (154.00) in PG 5, non fertile pods plant^{-1} (20.33) in Dohad yelow, under normal sown planting. In late sown planting the highest total number of pods plant^{-1} (107.66) in, fertile pods plant^{-1} (103.66) in GNG 469 and non fertile pods plant^{-1} (11.00) in K 850 were found in the variety PG 5 in normal planting and late planting GNG 469 variety gave the best performance regarding pod development and seed production. The result obtained from present investigation suggested that selection for morphological traits such as pod development could not only improve the heat tolerance of chickpea, but can also boost up the crop production under climate change, in addition to flowering period is an important factor limiting yield in chickpea.

Key words : Fertile pods, non fertile pods, high temperature, genotypes.

Introduction

Chickpea (*Cicer arietinum* L.) is considered one of the most drought-tolerant cool-season food legumes; heat stress still limits chickpea production. With terminal drought, seed yields can be reduced by 58–95% compared to irrigated plants and reductions in pod production and abortion are key factors impacting final seed yield (Leport *et al*., 2006). It is widely cultivated under a range of climatic conditions not only in Madhya Pradesh, but also in other states of India while M.P. ranks number one in production and productivity. Sowing time may vary in different locations depending on the temperature experienced at different stages of crop development. Temperature, climate change and shifting in date of sowing are therefore the most important growth parameter that governs yield and high temperatures or heat stress during the reproductive stage in chickpea is a major cause of yield loss. Global warming is predicted to increase temperature by upto 5°C by the end of this century, with associated changes in mean maximum temperature. There are two types of chickpea, namely 'desi' and 'Kabuli', respectively. The desi type has small, angular, dark-brown seeds, while kabuli types have large, rams-head-shaped, light-brown seeds (Malhotra *et al*., 1982). Both types are generally grown under rainfed conditions either on stored soil moisture in subtropical environments with summer dominant rainfall or on current rainfall in winter-dominant Mediterranean-type environments. In these environments, a water shortage and high temperature as the plant enters its reproductive phase induces the end of reproductive development (Siddique *et al*., 2000; Turner, 2003, 2004, 2006). This end-of-season drought is termed 'terminal heat stresses'. Yields of Kabuli chickpeas are less than desi chickpea under terminal stress and pod abortion by Kabuli chickpea is more sensitive to water stress than that of desi chickpea (Shukla, 20013). In the present study, promising genotypes under the chickpea project were used to investigate the effect of high temperature on total pods, fertile pods and

non fertile pods. High temperature was imposed when both cultivars had flower buds, flowers and developing pods. The objectives of the study were to investigate the influence of high temperature at different stages in the 31 chickpea genotypes.

Materials and Methods

The present investigation was carried out during *Rabi* 2012-13 under All India Coordinated Research Project on Chickpea (lead center) at Seed Breeding Farm, College of Agriculture, J.N.K.V.V., Jabalpur (M.P.), India. The experimental area occupied was quite uniform in respect of topography and fertility. The main features are hot and dry summer and cold winter with occasional showers. The average rainfall is about 1400 mm, which is received mostly during July to September. The temperatures vary from 4.0°C minimum in January to 42°C maximum in May. The crop season was favorable during experiment. The experimental material comprised of 31 promising genotypes of chickpea (table 1). These genotypes were grown in a Randomized Block Design with three replications on two different dates under normal planting on 22nd November 2012 and late planting on 9th January 2013. Each plot size was 3.0 m × 1.2 m = 3.6 m^2 consisting of 2 rows of 3m length, the row to row distance was 30 cm and plant to plant spacing was 10 cm. Fertilizer was applied in the ratio of 20N : $60P_2O_5$: $40K_2O$ kg/ha. The experiment was conducted with recommended agronomic practices.

Observations recorded

The crop was harvested from the central 3.6m^2 area with sickle at full maturity (*i.e.* when 95% pods become brown). BGD 103 and ICCV-92944 were shown early maturity than GG 2 within 100-102 DAS all plants become mature randomly selected pods were taken from each sample plants and average number of pods $plant^{-1}$ was determined. The pods contains at least one seed were counted as fertile pods. The number of pods having no seeds or with seeds ≤ 4mm diameter were counted as non fertile pods.

Results and Discussion

Environment-I (Normal planting)

Pod development was found in all the genotypes of the normal planting and the no. of pods $plant^1$ ranges from 162.00% to 27.66%. Maximum pod was observed in PG 5 (162.00) followed by RSG 945 (159.33) and GNG 663 (116.66) while it was recorded minimum in JG 11 (27.66). Out of thirty one genotypes maximum fertile pods percentage was recorded in PG 5 (154.00) followed by RSG 945 (151.66) and minimum in JG 11 (24.33). The maximum non fertile pods noted in genotype Dohad yelow (20.33) followed JG 218 (16.33), while it was recorded minimum in Avrodhi (1.33) in normal planting (table 2).

Table 1 : List of chickpea genotypes used in the experiment.

S. no.	Entry	S. no.	Entry
1.	ICCV 92944	17.	RSG 888
2.	JG 11	18.	L 550
3.	RSG 945	19.	GNG 469
4.	Annegiri	20.	K 850
5.	PBG 5	21.	RGS 991
6.	JGK 2	22.	BGD 103
7.	GG 2	23.	JG 218
8.	GCP 101	24.	Avrodhi
9.	Pusa 240	25.	PG 5
10.	PG 96006	26.	JG 74
11.	JGG 1	27.	RSG 143-1
12.	ICC 4958	28.	GNG 663
13.	Pusa Green 112	29.	Dohad yelow
14.	Pusa 244	30.	Vijay
15.	CSJD 884	31.	ICVV-92944
16.	Vaibhav		

Environment – II (Late planting)

The pod development % for late planting genotypes were slightly less as compare to the normal planting and it ranges from 107.33% to 26.33%. The maximum pods % was noted in genotype GNG 469 (107.66) followed by JG 218 (104.33) and JGG 1 (96.66). The minimum number of pods % was accounted in the Pusa Green 112 (26.33). The maximum fertile pods percentage was observed in the GNG 469 (103.66) followed by JG 218 (95.33) and JGG 1 (94.00) whereas it was noted minimum in the Pusa Green 112 (25.66). The maximum non fertile pods noted in K 850 (11.00) followed JG 218 (10.00) while it was recorded minimum in RSG 945 (1.33) in late planting (table 2).

In present scenario of climate change and shifting of date of showing, the genotype having maximum pod percentage with minimum non fertile pods should be given due consideration either they preferred any date of showing. In normal date of sowing, Avrodhi (1.33) and Pusa Green 112 (1.66) exhibited maximum fertile pods with minimum non fertile pods indicated their importance for timely planting. Similarly in second date of sowing late planting (107.66) followed by JG 218 (104.33) and JGG 1(96.66). Performed better to other genotypes under study. In late sown condition the GNG 469 (107.66) followed by JG 218 (104.33) and JGG 1 (96.66). Revealed promising having maximum fertile pods with minimum non fertile pods. The overall study indicated that the

Table 2 : Number of pods plant^{-1}, number of fertile pods^{-1} and non fertile pods^{-1} in normal and late sown planting.

S. no.	Entry name	Normal planting			Late Planting		
		Morphological characters			Morphological characters		
		No. of pods plant^{-1}	Fertile pods plant^{-1}	Non fertile pods plant^{-1}	No. of pods plant^{-1}	Fertile pods plant^{-1}	Non fertile pods plant^{-1}
1.	ICCV 92944	53.333	51.000	2.333	47.333	45.666	3.666
2.	JG 11	27.666	24.333	3.666	87.333	85.333	1.666
3.	RSG 945	59.333	151.666	12.000	45.666	44.333	1.333
4.	Annegiri	103.000	94.000	6.333	40.666	35.333	5.333
5.	PBG 5	58.333	43.666	14.666	60.333	51.000	8.666
6.	JGK 2	73.333	64.000	7.333	84.333	81.000	2.333
7.	GG2	86.000	69.333	15.333	52.666	47.333	5.666
8.	GCP 101	54.666	51.666	4.000	50.333	41.333	8.333
9.	Pusa 240	82.333	70.000	11.666	96.333	94.000	2.000
10.	PG 96006	34.000	31.000	5.333	64.666	62.666	2.666
11.	JGG 1	85.000	77.333	9.000	96.666	94.000	2.333
12.	ICC 4958	96.000	94.000	4.000	50.666	50.000	2.666
13.	Pusa Green 112	42.333	41.666	1.666	26.666	25.666	1.333
14.	Pusa 244	37.333	33.666	3.666	61.666	60.333	3.666
15.	CSJD 884	79.000	71.000	7.333	88.666	83.000	6.666
16.	Vaibhav	51.000	48.666	5.333	55.333	54.333	2.000
17.	RSG 888	54.333	43.666	11.000	53.333	52.666	2.333
18.	L 550	112.000	108.333	3.333	61.666	54.333	7.666
19.	GNG 469	77.000	74.000	3.333	107.666	103.666	6.666
20.	K 850	97.333	85.333	12.000	57.666	44.333	11.000
21.	RGS 991	75.666	62.000	16.333	38.000	34.000	5.333
22.	BGD 103	32.666	24.666	4.666	77.000	74.333	2.666
23.	JG 218	79.666	43.000	16.333	104.666	95.333	10.000
24.	Avrodhi	70.666	70.333	1.333	48.333	45.000	2.333
25.	PG 5	162.000	154.000	10.333	66.666	62.000	5.000
26.	JG 74	75.666	74.666	2.333	58.666	52.333	6.000
27.	RSG 143-1	47.333	44.666	2.000	45.666	43.333	3.000
28.	GNG 663	116.666	112.333	2.666	76.666	72.666	4.000
29.	Dohad yelow	93.666	74.333	20.333	45.333	42.333	2.333
30.	Vijay	41.333	33.666	9.333	56.333	52.333	3.000
31.	ICVV-92944	71.666	72.000	1.666	62.666	57.666	6.000
S.Em. ±		**2.400**	**1.503**	**0.679**	**0.473**	**0.986**	**0.523**
CD (5%)		**6.788**	**4.242**	**1.925**	**1.348**	**2.789**	**1.189**

chickpea genotypes Dohad yelow, PG 5 and G-3 found promising for normal date of sowing while genotype GNG 469, JG 218, JGG 1 and Pusa 240 were noted for late planting. The present results are in the conformity of the findings reported by Xiangwen Fang *et al*. (2009).

Conclusion

The genotype suitable for normal and late indicated its importance under terminal heat condition and should given due consideration under climate change and shifting date of sowing. The present study has demonstrated that terminal drought reduced flower and pod production, increased flower and non fertile pods therefore reduced seed yield in both chickpea cultivars, indicating that both flower and pod abortion are important in determining seed yield, while, secondly, it showed that initiation date significantly affected flower and pod development with early-initiated flowers and pods less likely to abort, while late-initiated flowers and pods largely aborted.

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