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Genotypic response to heat stress tolerance in Chilli (*Capsicum annuum* L.)

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Abstract
The present investigation was carried out at All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during summer 2017. Eighteen genotypes of chilli were evaluated for heat stress tolerance in two different planting dates. Ten characters were analyzed and had shown significant differences for all the traits during both the planting dates. Among all the genotypes highest fruit yield were observed in genotypes viz., RHRC-211, RHRC-206 and RHRC-212-1. The lowest fruit yield observed in RHRC-210. Maximum plant height was observed in Phule Jyoti, while higher branches/plant found in RHRC-208. Minimam days to flower initiation and days to 50% flowering observed in RHRC-209. Highest fruit setting percentage, fruits/plant and yield /plant was recorded by RHRC-216, RHRC-211 and RHRC-212-1 due to high pollen viability and tolerant to high temperature stress condition. Thus, these genotypes can be further be exploited during summer season *per se* or by involving in breeding programme

Keywords: Chilli, genotype, stress tolerance, planting dates, heat sensitive, yield

Introduction
Chilli is tropical and subtropical vegetable crop grown all over length and breadth of country in India. Planting time is also very crucial in any crop production system since it determines the extent of incidence and severity of disease infestation which in turn affects crop growth and yield. In general green chilli yields more as compare to red chilli. However, in summer season the production of green chilli is adversely affected due to large number of abiotic factors such as limited irrigation facilities, low relative humidity and high temperature which shoots up to 42ºC or even more in the tropical countries including India. There is a great demand for green chillies during summer months; fetching premium price during these months. There is urgent need to identify the genotypes suitable for summer season. Temperature is one of the most critical factor affecting growth and development of plant. Worldwide, extensive agricultural losses are attributed to heat and often in combination of drought and other abiotic stresses (Mittler, 2006) [10]. The response of plant to heat stress is complex and depends upon the signal that flow information to sense the change in surrounding environment and induces the gene expressions accordingly (Kotak *et al*., 2007) [7]. The growth of chilli is most optimum, when temperature ranges between 20-30 oc, but often decline during summer months when temperature increases above optimum range. However, summer months (March-June) are hot, dry and temperature remains above 35^{oc} with low relative humidity (30-45 %). In chilli and brinjal marked reduction in yield has been observed with high night (22-24 $^{oc)}$ and day (33-39 $^{oc)}$ temperature (Mohanty and Prusty, 2000) [11]. The rate of fruit setting reported to decrease with increasing average maximum temperature and higher precipitation during first five days of anthesis. Lombardi and Restaino (1981) [9] observed influence of both temperature and genotype on anthesis, but fruit set was affected more by genotype. Warner and Erwin (2005) [21] observed natural variation for floral bud abortion at high temperature in *Arabidopsis thalianin*. Therefore, chilli genotypes were evaluated for heat stress tolerance in present study.

Materials and Methods
The present investigation was conducted at All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during summer 2017. Total of 18 genotypes were evaluated for 10 characters in randomized block design with three replications in two planting dates viz., 1st February and 1st March, 2017. The seeds were sown on 15th December, 2016 and 15th January, 2017 and transplanting were done after six week when seedlings attained 15-20 cm height at spacing of 60x 45 cm. All the cultural practices and plant protection measures were followed as and when

required to raise a healthy crop. The data was recorded for the horticultural traits, such as plant height (cm), number of branches per plant, days to initiation of flowering, days to 50 % flowering, fruit length (cm), fruit diameter (cm), average weight of fruit (g), fruit setting (%), number of fruits per plant and yield per plant (g). Observations were recorded from five plants selected randomly in each genotype and each replication. The data were subjected to statical analysis and analyzed as per method suggested by Panse and Sukhatme (1985) [13].

Results and Discussions

The data presented in Table 1 revealed that the significant differences among genotypes were found for all the traits in both planting dates (D1 and D2). Yield is prime objective of breeding programme, which depends upon the number of traits such as plant height, number of branches per plant, days to initiation of flowering, days to 50 % flowering, fruit length, fruit diameter, average weight of fruit, fruit setting (%), number of fruits per plant and yield per plant (g). There was high variability among the genotypes under the investigation in both the planting dates, which indicated the scope for improvement of total fresh yield of chilli.

Significant differences were observed for all the 10 characters during both dates of chilli planting. Plant height is one of the important growth character and is a dominant part of plant architecture. It is strongly associated with life span, maturity as well as yield. It decides the overall structure of the plant and shows extent of growth vigor in plant. The data presented in Table 1 showed that genotype Phule Jyoti recorded significantly maximum plant height (62.46 &59.67 cm) respectively in both the planting dates. Higher plant height during *summer* season in both planting dates may be due to longer period of vegetable growth and unfavorable conditions for reproduction or fruit setting during hot summer months in semi-arid region of western Maharashtra. Similar findings in respect of plant height of different chilli genotypes were reported by Sreelathakumary and Rajamony (2004) [18], Sandeep *et al.* (2008) [154], and Dhaliwal *et al.* (2014) [4]. Datt and Kaur (2017) mentioned similar reports in Brinjal at Punjab condition. Whereas number of branches /plant ranges from 4.67 to 8.33 in both planting dates. The significantly highest number of branches/plant was recorded by genotype RHRC-208 in both planting dates respectively. Similar type of variations related to number of primary branches per plant in chilli was reported by the scientists Smitha and Basavaraja (2006) [17], Ukkud *et al.* (2007), Singh and Jain (2009) [16], Amit *et al.* (2014) [1].

The days required for initiation of flowering ranged from 36.67 to 55.0 and minimum days to flower initiation and 50% flowering was recorded by genotype RHRC-209 (36.67 & 37.0 days and 40.0&41033 days) respectively in both planting dates. The difference in flowering during summer season may be due to difference in effective accumulative temperature during summer season is in increasing order and vice versa during rainy season. The difference in the days for initiation of flowering might be due to specific genetic makeup which decides the character. Since the prevailing temperature during summer month increasing order. Above findings regarding the variation in days to initiation of flowering in different chilli genotypes are in conformity with Ukkud *et al.* (2007) and Amit *et al.* (2014) [1] in chilli..The significantly highest fruit length was recorded by the genotype RHRC-215 (6.87 &6.70 cm) respectively in both the planting dates. However, highest fruit diameter was recorded by genotype RHRC-210 (1.0cm) each in both the planting dates respectively. Fruit length of any chilli genotype is governed by genetic character and hence it may vary as per the genotype. The variation in chilli in fruit length was also reported by Sreelatha kumary and Rajamony (2004) [18], Smitha and Basavaraja (2006) [17]. Significantly maximum fruit setting percentage was recorded by genotype RHRC-206 (52.33 & 51.10 %) respectively in both the planting dates. This may be due to the although conditions are favorable for vegetative growth but not for fruit setting. Leavy *et al.* (2007) observed that fruit set varied from 77.3-16.3 % in heat tolerant and heat sensitive genotypes of tomato, respectively. Accourding to them, the characters contributing to low fruit set were the bud drop andreduction in quantity and functionality of gamates. Such variation in chilli genotypes for per cent of fruit set was reported by Smitha and Basavaraja (2006) [17], Singh and Jain (2009) [16], and Chattopadhyay *et al.* (2011).

Significantly maximum number of fruits/plant were observed in genotypes RHRC-216 (76.0& 74.67), RHRC-212-1 (73.0 &72.33), RHRC-209(72.33& 66.67), RHRC-211(71.67 & 71.0) and RHRC-206 (70.0 & 69.33) respectively in both planting dates. These genotypes possessing more number of fruits/plant at high temperature is an indication of inherent heat tolerant ability. As hot and dry months of summer causes reduction in pollen viability and ultimately fruit setting and number of fruits/plant. Least fluctuation due to planting dates on fruits /plant was observed in all genotypes under study. Such variation in chilli genotypes for number of fruits per plant was also noticed by Sreelathakumary and Rajamony (2004) [18], Tembhurne *et al.* (2008) [19], Singh and Jain (2009) [16] and Chattopadhyay *et al.* (2011) [2].

Fresh chilli fruit yield per plant significantly differed in all genotypes in both the planting dates. The maximum fresh fruit yield /plant was recorded by genotypes RHRC-211 (406.37 & 390.50 g), RHRC-206 (401.10 & 376.46 g), RHRC-212-1 (394.20 & 376.12 g), Phule Jyoti (392.53 & 384.71 g) and RHRC-215 (388.05 & 384.12 g) respectively in both the planting dates. Least fluctuation due to planting dates on fruits /plant was observed in all genotypes under present investigation. The genotype RHRC-210 was found most sensitive to heat and which recorded the lowest fresh fruit yield/plant. The higher fruit yield/plant may be due to high fruit set and more number of fruits /plant while lower fruit yield may be due to vice versa effects as explained above. The variation in chilli genotypes for yield per plant was also noticed by Janaki *et al.* (2005) [6], Tembhurne *et al.* (2008) [19], Cheema *et al.* (2010) [3], Amit *et al.* (2014) [1], Rohini and Lakshmanan (2014) [14].

Table 1: Growth and yield Performance of chilli genotypes under summer season in different planting dates.

Sr. No.	Name of genotypes	Plant height (cm)		No. of branches /plant		Days to flower initiation		Days to 50 per cent flowering		Fruit length (cm)		Fruit diameter (cm)		Average weight of fruit (g)		No. of fruits/ plant		Fruit set (%)		Yield / plant (g)	
		D-1	D-2	D-1	D-2	D-1	D-2	D-1	D-2	D-1	D-2	D-1	D-2	D-1	D-2	D-1	D-2	D-1	D-2	D-1	D-2
1	RHRC-201	48.67	48.00	5.33	4.67	55.67	58.00	60.33	62.33	5.63	5.60	0.97	0.93	5.70	5.77	62.00	61.33	45.00	44.33	353.40	353.87
2	RHRC-203	45.33	46.00	6.33	6.00	5, 33	50.33	56.00	57.67	4.77	4.67	0.97	0.95	5.75	6.00	61.00	60.33	45.00	43.50	350.75	361.98
3	RHRC-205	48.33	50.33	6.33	6.33	49.67	50.33	52.33	54.00	5.13	5.10	0.84	0.84	5.17	5.20	58.33	57.67	41.67	40.65	301.56	299.88
4	RHRC-206	60.33	58.00	6.00	6.20	48.00	49.33	54.67	56.67	5.87	5.37	0.93	0.94	5.73	5.43	70.00	69.33	50.33	48.67	401.10	376.46
5	RHRC-207	43.33	41.33	7.67	7.33	43.33	44.33	51.67	53.67	5.43	4.40	0.93	0.92	5.37	5.27	59.00	57.67	45.67	44.00	316.83	303.92
6	RHRC-208	57.67	56.67	8.33	8.00	47.33	45.33	50.33	51.67	4.60	4.45	0.84	0.80	5.27	5.10	60.00	58.00	47.67	47.33	316.20	295.80
7	RHRC-209	58.33	57.67	5.67	5.33	36.67	37.00	40.00	41.33	4.77	4.93	0.82	0.81	5.03	5.07	72.33	66.67	52.30	50.67	363.82	338.02
8	RHRC-210	45.67	44.33	5.67	5.67	65.67	68.33	69.33	71.33	4.97	5.37	1.00	1.00	4.93	4.97	58.00	57.33	42.00	41.67	285.94	284.93
9	RHRC-2010-1	44.33	43.00	7.67	7.33	45.67	43.00	48.00	47.67	6.00	6.15	0.84	0.85	5.80	5.60	61.67	60.00	45.00	43.80	357.68	336.00
10	RHRC-211	58.67	57.33	6.33	6.00	49.00	50.33	52.67	53.33	5.33	5.20	0.95	0.92	5.67	5.50	71.67	71.00	50.00	49.67	406.37	390.50
11	RHRC-212	46.67	45.33	4.67	4.50	45.60	44.50	47.33	49.33	6.10	5.93	0.81	0.83	5.80	5.76	61.00	60.67	46.00	46.43	353.80	346.46
12	RHRC-212-1	48.00	47.33	7.33	7.00	46.67	48.60	48.33	50.33	5.17	5.00	0.93	0.90	5.40	5.20	73.00	72.33	51.00	51.10	394.20	376.12
13	RHRC-213	59.33	58.00	7.00	6.80	46.67	48.00	49.33	50.33	6.50	6.32	0.87	0.85	5.90	5.24	61.33	59.67	47.00	46.67	361.84	348.27
14	RHRC-214	48.33	48.67	7.00	6.60	48.67	49.00	51.33	52.67	5.67	5.50	0.90	0.88	5.27	5.20	59.33	59.33	44.33	43.00	330.47	308.51
15	RHRC-215	57.00	56.67	6.00	5.33	51.33	52.00	54.00	55.33	6.87	6.70	0.75	0.78	5.97	5.94	65.00	64.67	49.67	48.40	388.05	384.12
16	RHRC-216	60.00	59.33	6.00	5.80	45.33	46.50	47.67	49.67	6.00	5.97	0.90	0.88	4.67	4.73	76.00	74.67	52.33	51.10	354.92	353.19
17	RHRC-218	58.67	59.00	7.67	7.33	49.00	50.67	52.67	53.67	6.60	6.72	0.77	0.78	5.93	5.80	61.67	59.67	47.00	46.67	365.70	350.26
18	Phule jyoti	62.46	59.67	6.67	6.33	53.33	55.00	57.67	60.67	6.20	6.13	0.85	0.83	5.83	5.83	67.33	66.33	49.33	48.00	392.53	384.71
	S.E +-	1.13	1.15	0.60	0.62	3.08	2.13	2.99	2.77	0.23	0.17	0.04	0.04	0.23	0.24	0.89	2.02	1.51	1.48	14.17	18.49
	C.D. at 5%	3.25	3.30	1.72	1.77	8.85	6.13	8.60	7.95	0.66	0.48	0.11	0.13	0.66	0.68	2.56	5.80	4.34	4.25	40.74	53.15
	C.V. (%)	3.08	3.15	12.50	13.98	9.91	6.56	8.70	7.81	5.70	4.17	5.60	6.81	6.00	6.23	2.00	4.56	4.58	4.50	6.89	7.74

D1: First planting date (1st February) D2: Second planting date (1st March)

Conclusion

In present study, out of 18 chilli genotypes RHRC-211, RHRC-206 and RHRC-212-1 gave maximum fresh fruit yield during summer season in both the planting dates due to high pollen viability, more fruit setting and fruits/plant. Thus, these three genotypes can be evaluated further in multilocation trial to release as a heat tolerant varieties or can be involved in breeding programme to get transgressive segregants to cope with changing climate.

References

1. Amit K, Ahad I, Kumar V. Genetic variability and correlation studies for growth and yield characters in chilli (*Capsicum annuum* L.) J Spices and Aromatic crops. 2014; 23(2):170-177.
2. Chattopadhyay AA, Sharangi AA, Dai N, Dutta S. Diversity of genetic resources and genetic association analyses of green and dry chillies of Eastern India. Chilean J Agril. Res. 2011; 71(3):2-6.
3. Cheema DS, Jindal SK, Dhaliwal MS. Evaluation of chilli hybrids developed by using genetic male sterility. Haryana s J Horti. Sci. 2010; 39(3, 4):321-325.
4. Dhaliwal MS, Garg N, Jindal SK, Cheema DS. Heterosis in chilli (*Capsicum annuum* L.) using genetic male sterility Res Punjab Agric Univ. 2014; 51(3, 4):255-261.
5. Dhatt AS, Manpreet Kaur. Genotypic response to heat stress tolerance in brinjal (*Solanum melongena* L). Veg. Sci. 2017; 44(2):8-11.
6. Janaki M, Naidu N, Ramona CV, Parat PM. Assessment of genetic variability, heritability and genetic advance for quantitative traits in chilli (*Capsicum annuum* L.). Int. J Life Sci. 2005; 10(2):729-733.
7. Kotak S, Larkindale J, Lee U, Von KP, Vierling E, Scharf KD. Complexity of the heat stress response in plants. Curr. Opin. Plant Biol. 2007; 10:310-316.
8. Levy A, Rabinowitch HD, Kedar N. Morphological and physiological characters affecting flower drop and fruit set of tomatoes at high tempertures. Euphytica. 2007; 27:211-218.
9. Lombardi, Restaino. Solanaceous Crops. In: Bose T K. and Som M.G. Etd. Vegetable Crops in India, Naya Prakash, Culcutta, 1981, 293-342.
10. Mittler R. Abiotic stress, the field environment and stress combination. Trends Pl. Sci. 2006; 11:15-19.
11. Mohany BK, Prusty AM. Genotype x environment interaction and stability analysis for yield and its composition in brinjal and chilli. Indian J Agric. Sci. 2000; 70:370-373.
12. Mohany SK, Kanwar JS, Gill BS. Flowering and fruit setting pattern in brinjal and chilli cultivars induced by seasonal variations. Seed Res. 2002; 30:104-108.
13. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. ICAR Rev. Ed. By Sukhatme, P. V. and Amble, VN. 1985, 145-156.
14. Rohini N, Lakshmanan V. Evaluation of chilli hybrids for yield and related traits. Trends in Biosci. 2014; 7(22):3635-3638.
15. Sandeep DP, Bidar B, Shashidhara GB, Hanamashetti SI. Evaluation of chilli genotypes for ghataprabha left bank command area in karnataka. The Asian J Horti. 2008; 3(2):356-360.
16. Singh PD, Jain SK. Evaluation of exotic and indigenous genotypes of chilli (*Capsicum annuum* L.) under foot hills of Himalayas during summer season. Pantnagar J Res. 2009; 7(1):10-12.
17. Smitha RP, Basavaraja N. Variability and Correlation Studies in Chilli (*Capsicum annuum* L.). Karnataka J Agri. Sci. 2006; 19(4):888-891.
18. Sreelathakumary I, Rajamony L. Variabity heritability and genetic advance in Chilli (*Capsicum annum* L.). J Tropical Agri. 2004; 42(1, 2):35-37.

19. Tembhurne BV, Revenappa, Kuchanur PH. Varietal performance genetic variability and correlation studies in chilli (*Capsicum annuum* L.). Karnataka J Agri. Sci. 2008; 21(4):541-543.
20. Ukkund KM, Madalageri MB, Pati, MP, Mulage R, Kotikal YK. Variability studies in green Chilli (*Capsicum annuum* L.) Karnataka J Agri. Sci. 2007; 20(1):102-104.
21. Warner RM, Erwin JE. Naturally occurring variation in high temperature induced floral bud abortion across Arabidopsis thaliana accessions. Plant Cell Environ. 2005; 28:1255-1266.