AU DOI: 10.15740/HAS/AU/12.TECHSEAR(5)2017/1416-1420 *Agriculture Update*
Volume **12** | TECHSEAR-5 | 2017 | 1416-1420 Visit us : *www.researchjournal.co.in*

RESEARCH ARTICLE :

Chench (*Corchorus acutangulus* Lam.) seed germination under the influence of different temperature regimes

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ARTICLE CHRONICLE :
Received :
15.07.2017;
Accepted :
30.07.2017

SUMMARY : Temperature greatly influences germination of the seeds. Most of the varieties lack the ability to sustain temperature stress with significant differences for germination and related traits. Laboratory investigations were conducted to determine the effect of different temperature regimes on germination traits of various chench (*Corchorus acutangulus* Lam.) grnotypes at Department of Genetics and Plant breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2015. Seeds of forty six genotypes were tested for germination and related traits under three temperature regimes (10, 20 and 30^{o}C) in germinator. The increase in temperature significantly enhanced germination and related traits. All the chench genotypes germinated well (80-97%) sown at 20-30^{o}C, whereas, shoot length was maximum in IGCB-2015-14 and IGCB-2013-2 sown at 30 and 20^{o}C, respectively. Root length, including seed vigor index were maximum with increasing temperature. The maximum seed germination, vigor index occurred at 20-30^{o}C and these temperature regimes were identified as optimum for chench seed germination.

KEY WORDS :
Chench, Temperature, Germination, Genotypes

How to cite this article : Rana, Bhupendra Singh, Sharma, Pravin Kumar, Dixit, Amit, Kurre, Vivek Kumar and Paikra, Rahul Singh (2017). Chench (*Corchorus acutangulus* Lam.) seed germination under the influence of different temperature regimes. *Agric. Update*, **12**(TECHSEAR-5) : 1416-1420; **DOI: 10.15740/HAS/AU/12.TECHSEAR(5)2017/1416-1420.**

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BACKGROUND AND OBJECTIVES

Chench (*Corchorus acutangulus* Lam.) is one of the unexploited and underutilized leafy vegetable and also know as vegetable jute in India. Chenh is one of the main species of taxonomically diverse group of leaf vegetables. The nutritional value of chench is excellent because of its high content of essential minerals (iron, calcium) and good source of vitamins (vitamin C and folic acid). Chench belongs to the genus Corchorous of the family Tiliaceae. *Corchorous* has many species which are used as leafy vegetables, Many wild species occurs out of which, only seven species are cultivated *C. fascicularis, C. trilocularis, C. acutangulus, C. tridens, C. capsularis, C. olitorius, C. depresses* (Choudhary *et al.*, 2013). It is widely cultivated throughout India especially during the summer and rainy seasons. There was little information on the extent and kind of diversity present in the collection maintained in Chhattisgarh, hence characterization and preliminary evaluation of these genotypes was considered an important area of study.

Seed germination is a factor which contribute yield of the crop. Among the abiotic factors, temperature is considered an important issue for germination, because it persuades the rate of water and additional substrates necessary for growth and development. In now day, fluctuation in temperature may influence germination of chench which could be predicted due to genotypic variation. Germination may be dependent on the ability of seed to utilize reserves more efficiently (Rao and Sinha, 1993), by mobilization of seed reserves for germination traits (Penning de Vries *et al*., 1979). Temperature is a modifying factor in germination since it can influence the rate of water absorption and other substrates supply are necessary for growth and development (Wanjura and Buxtor, 1972 and Essemine *et al*., 2002). The rapid and uniform field emergence is essential to achieve better growth and high yield (Parera and Cantliffe, 1994). The optimal temperature favors a good aptitude to germinate, whereas low and high temperature extends delay in germination.High temperatures damage photosynthetic membranes (thylakoids) and cause chlorophyll loss (Al-Khatib and Paulsen, 1984), decrease leaf photosynthetic rate, increase embryo abortion (Saini *et al*., 1983), lower grain number, and decrease grain filling duration and rates (Wardlaw and Moncur, 1995; Wheeler *et al*., 1996; Ferris *et al*., 1998 and Prasad *et al*., 2006) thus resulting in lower grain yield (Wardlaw *et al*., 1989; Stone and Nicolas, 1994; Wheeler *et al*., 1996; Ferris *et al*., 1998 and Gibson and Paulsen, 1999). At the molecular level, high temperatures adversely affect cell metabolism (Berry and Björkman, 1980 and Levitt, 1980) and cause changes in the pattern of protein synthesis (Lindquist, 1986; Vierling, 1991 and Larkindale *et al*., 2005). Supra-optimal temperatures suppress the synthesis of the normal complement of cellular proteins and at the same time induce the synthesis and accumulation of many new proteins including heat shock proteins (Vierling, 1991; Feder and Hofmann, 1999 and Law and Brandner, 2001). The minimum and maximum temperatures can effect from seed germination to seed maturation (Lobell and Ortiz-Monasterio, 2007).This study therefore was set to determine how different temperature regimes affect chench seed germinating traits and to explore optimum temperature for germinability of different chench genotypes.

RESOURCES AND METHODS

Laboratory experiments were conducted to evaluate the germination traits of various chench genotypes under various temperature regimes at Department of Genetics and Plant breeding, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2015. Seeds of forty six genotypes were tested under three temperature regimes (10, 20 and 30^{o}C). A set of fifty randomly selected seeds of each genotype were placed in petri dishes having 13.5 cm diameter (50 seeds in each Petri dish) on double layer of Whatman filter paper No.1 and kept in the germinator (ModelPL3) at various temperatures as mentioned above. The seeds were moistened whenever necessary. The germination was recorded after 48 hours. The shoot, root length were recorded after 7 days. Seed vigor index from same lot was calculated by multiplying germination percentage and seedling length.

Seed germination of each genotype was tested as per ISTA (Anonymous, 1985) and germination percentage of each replication was worked out by using following formula:

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds placed for germination}} \times 100$$

Seed vigor index was calculated as per the formula given by Abdul-Baki and Anderson (1973)

Seed vigor index = Germination percentage × seedling length (cm)

OBSERVATIONS AND ANALYSIS

Seed germination and vigorous seedlings are important characteristics for wheat which could provide advantages for crop establishment. In this study, temperature significantly influenced germination and related traits of various chench genotypes. The highest germination (98%) was recorded in IGCB-2013-14 treated with 30^{o}C, IGCB-2015-12 (72%) and IGCB-2013-1 (94%) treated with 10 and 20^{o}C, respectively. The results further revealed lower germination IGCB-2013-15 (4%), IGCB-2015-12 (62%) and IGCB-2015-12 (68%) treated with 10, 20 and 30^{o}C, respectively. In

Table 1 : Germination %, root length, shoot length and seed vigor index of different genotype of chench under the influence of different temperature regimes

Genotypes	Germination %			Root length			Seedling length			Seed vigor index		
	10ºC	20ºC	30 ºC	10 ºC	20 ºC	30 ºC	10 ºC	20 ºC	30 ºC	10 ºC	20 ºC	30 ºC
IGCB-2013-1	14	94	96	0.72	4.34	1.90	0.23	2.46	3.40	3.22	231.24	326.40
IGCB-2013-2	12	72	88	0.53	3.20	4.70	0.36	3.18	2.44	4.32	228.96	214.72
IGCB-2013-3	6	88	92	0.57	2.58	1.92	0.45	2.92	2.68	2.70	256.96	246.56
IGCB-2013-4	10	78	84	1.21	4.46	2.90	0.36	2.10	3.52	3.60	163.80	295.68
IGCB-2013-5	16	74	82	0.92	4.32	3.48	0.31	2.18	2.74	4.96	161.32	224.68
IGCB-2013-6	14	82	92	0.72	3.06	3.26	0.37	2.04	3.52	5.18	167.28	323.84
IGCB-2013-7	16	90	90	0.64	3.88	4.30	0.26	2.44	3.14	4.16	219.60	282.60
IGCB-2013-8	20	76	86	1.64	4.04	3.00	0.24	1.94	2.70	4.80	147.44	232.20
IGCB-2013-9	32	80	88	1.83	5.02	3.94	0.27	1.84	2.96	8.64	147.20	260.48
IGCB-2013-10	28	82	90	0.73	3.62	2.56	0.41	3.02	2.50	11.48	247.64	225.00
IGCB-2013-11	4	76	84	0.46	1.74	4.08	0.38	2.64	2.52	1.52	200.64	211.68
IGCB-2013-12	58	74	80	1.72	4.12	3.64	0.39	1.80	2.90	22.62	133.20	232.00
IGCB-2013-13	48	72	80	1.27	4.24	4.54	0.24	2.42	3.00	11.52	174.24	240.00
IGCB-2013-14	6	78	98	0.68	4.52	5.14	0.26	2.22	3.06	1.56	173.16	299.88
IGCB-2013-15	4	74	80	0.46	4.28	5.46	0.24	2.34	2.20	0.96	173.16	176.00
IGCB-2013-16	8	76	94	0.83	4.58	5.18	0.52	2.02	2.84	4.16	153.52	266.96
IGCB-2013-17	12	74	80	0.67	2.18	4.00	0.34	3.02	3.30	4.08	223.48	264.00
IGCB-2013-18	8	74	82	0.73	3.84	3.86	0.32	1.52	3.24	2.56	112.48	265.68
IGCB-2013-19	14	70	86	0.63	3.20	3.64	0.38	2.84	2.56	5.32	198.80	220.16
IGCB-2013-20	12	88	88	0.53	3.96	5.70	0.22	2.06	1.92	2.64	181.28	168.96
IGCB-2013-21	10	74	82	0.64	4.02	4.04	0.34	1.58	2.94	3.40	116.92	241.08
IGCB-2013-22	16	76	80	0.71	4.34	2.48	0.38	2.66	2.76	6.08	202.16	220.80
IGCB-2013-23	6	70	74	0.65	3.16	2.52	0.33	2.60	2.82	1.98	182.00	208.68
IGCB-2013-24	12	74	74	0.82	3.60	2.66	0.37	2.72	2.88	4.44	201.28	213.12
IGCB-2013-25	10	76	82	0.76	2.30	2.22	0.28	2.54	2.70	2.80	193.04	221.40
IGCB-2015-1	28	76	82	1.23	4.12	2.78	0.24	2.28	4.06	6.72	173.28	332.92
IGCB-2015-2	16	90	90	1.41	2.10	2.54	0.31	2.12	3.70	4.96	190.80	333.00
IGCB-2015-3	6	88	92	0.91	3.96	3.40	0.36	1.74	3.36	2.16	153.12	309.12
IGCB-2015-4	8	84	94	0.84	1.80	2.20	0.24	2.16	4.06	1.92	181.44	381.64
IGCB-2015-5	16	82	90	0.76	2.20	2.56	0.29	2.70	3.78	4.64	221.40	340.20
IGCB-2015-6	14	72	84	0.64	3.56	2.78	0.46	1.92	3.06	6.44	138.24	257.04
IGCB-2015-7	20	78	86	0.88	3.10	4.08	0.43	2.34	4.52	8.60	182.52	388.72
IGCB-2015-8	24	76	86	1.73	3.44	4.72	0.48	2.36	3.76	11.52	179.36	323.36
IGCB-2015-9	40	76	82	1.82	3.72	2.14	0.37	1.84	3.74	14.80	139.84	306.68
IGCB-2015-10	38	70	74	1.62	3.16	3.44	0.34	2.34	3.34	12.92	163.80	247.16
IGCB-2015-11	10	74	70	0.78	4.64	3.46	0.36	2.08	3.58	3.60	153.92	250.60
IGCB-2015-12	72	62	68	1.86	5.10	3.36	0.32	1.82	3.34	23.04	112.84	227.12
IGCB-2015-13	50	90	96	1.63	2.00	4.38	0.29	3.06	2.94	14.50	275.40	282.24
IGCB-2015-14	16	86	94	0.82	3.20	2.46	0.26	2.30	5.06	4.16	197.80	475.64
IGCB-2015-15	14	66	80	0.73	3.58	3.90	0.24	1.34	2.86	3.36	88.44	228.80
IGCB-2015-16	38	92	96	1.26	3.64	4.42	0.37	2.80	3.54	14.06	257.60	339.84
IGCB-2015-17	12	74	88	0.71	4.86	1.08	0.34	1.86	4.64	4.08	137.64	408.32
IGCB-2015-18	26	80	92	0.93	1.90	2.78	0.47	1.84	4.26	12.22	147.20	391.92
IGCB-2015-19	12	74	76	0.73	2.60	3.00	0.46	2.72	4.28	5.52	201.28	325.28
IGCB-2015-20	24	70	80	1.24	2.30	1.96	0.43	2.34	3.20	10.32	163.80	256.00
IGCB-2015-21	18	76	86	0.82	2.14	2.14	0.33	2.10	3.52	5.94	159.60	302.72

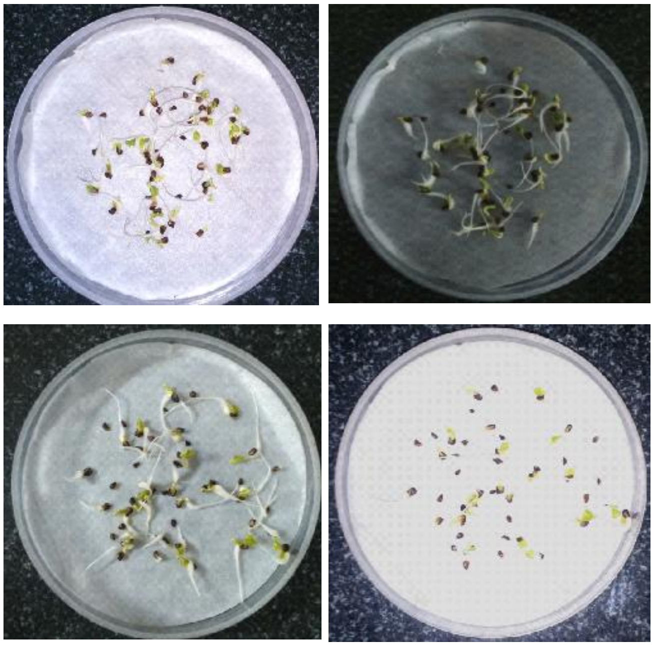

Fig. 1 : Germination test of chench seeds at different temperature regime

this study, at 20 and 30 °C no specific trend of increasing or decreasing was observed in chench seed germination Table 1. This could be predicted due to genetic potentiality of the chench genotypes to withstand the temperature fluctuation. Al-Qasem *et al*. (1999) reported that no germination occurred at 5°C. Total germination percentage for large seeds was significantly higher than that for small seeds. At 10°C, the cumulative germination percentage was significantly higher in F8 than Hourani-27. At 15°C, no significant differences were found between these two genotypes, but at 20 and 30°C, the cumulative germination percentage tended to be higher for Hourani-2, respectively. With regard to root length and seedling length application of 30°C to IGCB-2013-20 significantly increased root length (5.70 cm), followed by, 5.10 cm root length in IGCB-2015-12 treated with 30 and 20°C, respectively. Further decrease in temperature regime below 20°C drastically reduced the root length of all the chench genotypes were in seedling length also found maximum shoot length (5.06 cm) was recorded in IGCB-2015-14, IGCB-2013-2 (3.18 cm) and IGCB-2013-16 (0.52 cm) at 30, 20 and 10 °C, respectively (Table 1). Seed vigor index is an indicator of rapid germination and speed of growth. It was superior in seed of IGCB-2015-14 (475.64 cm) and IGCB-2015-13 (275.40 cm) treated with 30 and 20°C, respectively, however decrease in seed vigor index was noted in the lower temperature of IGCB-2015-12 (23.04 cm) at 10°C Table 1. Sikder and Paul (2010) also reported higher seed vigor index at optimum temperature in wheat.

In this study, chench genotypes differed significantly for germination and related traits. Robert *et al*. (2008) also reported varietal differences for vigor and germination traits. Mahan *et al*. (1995) observed that thermal stress influence morphology and physiology of the root system which may influence water movement through the plant. Moreover, roots are an important sink for assimilates in wheat. Since remobilization of assimilates occurs after anthesis, assimilates from roots may supplement primary sources from the leaf and stem (Hay and Walker, 1989). Nyachiro *et al*. (2002) reported that most genotypes recorded higher germination as temperature increased from 10 to 30°C. Our findings are in agreement with the above statement, whereas the differences in seed germination percentage at 10°C and 30°C may be due to genetic variation. Rawson (1986) demonstrated some of the genetic variation in heat tolerance that exists between wheat genotypes. Paulsen (1994) was also of the opinion that when assessing genotypic differences in tolerance to temperature stress, consideration must be given to the duration of the heat stress and the criteria used for evaluating tolerance. In this study, correlation analysis showed positive relationship between germination and its related traits. The increase in seedling shoot length increased root length.

Conclusion :

Regarding temperature effects on seed germination and related traits, the seeds of with 30°C responded well for germination, seed vigor index, shoot and root length for all genotypes.

Acknowledgement :

I am heartily thankful to Dr. Pravin Kumar Sharma and Vivek Kumar Kurre, my family and friends for their suggestion and support in search of literature and in compiling this paper. The authors are also grateful to publishers/authors/editors of all those books, articles and journals from where the literature for this article has been reviewed and discussed.

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