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Effect of Seed Testing Temperature on Germination of Bhendi Seed

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Temperature is one of the factors which play a major role in deciding the planting value of a seed lot in the seed testing laboratory. The temperature requirement varies with species. High or low temperature may stimulate or inhibit the germination of seeds under testing. The tropical crops may require higher temperature than temperate crops for germination. Eventhough, a seed lot is having high germination and vigour parameter, it could be revealed with suitable seed testing temperature only. Since bhendi is a tropical vegetable crop, two varieties of bhendi, Arka Anamika and CO4 with each five different lots were tested with four different temperature regimes *viz.,* 15, 20, 25 and 30ºC. The experimental results revealed that bhendi seeds performed well at the temperature regime of 30ºC followed by 25ºC which was on par with each other. It was also accompanied with seed

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quality characteristics of seedling length, vigour index and dry matter production of seedlings. Irrespective of varieties and lots studied, the high temperature showed its superiority over other temperatures. The study also disclosed that the low temperature of 15ºC was not suitable for bhendi seed germination, because none of the seeds produced normal seedling. At low temperature seeds could produce more abnormal seedlings than rest of the temperature regimes studied. It could be inferred that the seed testing temperature suitable for bhendi seed germination is 30°C or 25°C. Low temperature (15°C) is not suitable, since the normal seedlings were not produced at this temperature.

Keywords: Bhendi; germination; seed testing temperature; vigour; standardization.

1. INTRODUCTION

The germination capacity of any seedlot is a crucial aspect of its quality. Germination is defined as the process in which seeds begin to uptake water, followed by elongation of the embryo and penetration of the radical through the endosperm and seed coat. In order to increase the production of commercial horticultural practices, the proper seed testing must be done to reduce the failure of crops in the field condition. Seed testing is the basic method for planting value of seeds to minimize the risks of failure in planting low quality seeds. The temperature for germination of bhendi seeds was between 24 to 27ºC [1-4]. The existing seed testing procedure for conducting germination tests in bhendi is to be re-standardized for temperature requirement. These are important for conducting germination test in seed testing laboratory to assess the planting value of seed. Since bhendi is a tropical crop, an attempt was initiated to identify whether the seed testing temperature influence the seed germination and seedling characteristics [5-8].

2. MATERIALS AND METHODS

The experiment on Bhendi seed testing through different temperature regimes in the varieties Arka Anamika and CO4 with each five different lots were conducted in the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2022.The basic seed materials were collected from the Department of Vegetable crops, Coimbatore; Vegetable Research Station, Palur; Horticultural College and Research Institute, Periyakulam and Horticultural College and Research Institute for Women, Tiruchirappalli. The seeds of two varieties, lot wise and replication wise were placed for germination in roll towel medium and kept at four different temperature regimes *viz.,* 15, 20, 25 and 30ºC.

The germination percent, abnormal seedlings percent, hard seed percent, dead seed percent, root and shoot length, vigour index and dry matter production were the parameters observed. The Germination (%) was arrived by conducting the germination test as per ISTA (2019) in roll towel method. On fifteenth day of sowing, the number of normal seedlings from each lot was counted replication wise, and the mean values were calculated and expressed in per cent (%). Seedlings which do not have normal root growth or shoot growth were considered as abnormal. The abnormal seedlings were counted from each replication and the mean value was expressed in percentage. At the end of the test period the seeds which remained hard without absorbing moisture were counted and the mean was denoted as percentage of hard seed. At the end of germination test period the seeds which were not germinated, when pressed release milky paste like substance is considered as dead seeds. The number of dead seeds were counted and denoted in percentage.

Root and Shoot length from randomly selected ten normal seedlings were calculated and expressed in centimeter. For dry matter production, the normal seedlings were shade dried for 24 hours and then dried in a hot air oven method at 80ºC for 24 hours. Dried seedlings were weighed and mean values were computed and reported in gram per 10 seedlings. Vigour index values were computed using the following formula [9].

> Vigour index = Germination% x Seedling length in cm (Root length + Shoot length)

The experiment was conducted using a Factorial Completely Randomized Design (FCRD) with four replications.

2.1 Statistical Analysis

The data obtained were analysed for the F test of significance adopting the procedure described by [10]. Wherever necessary, the per cent values

were transformed to angular values using arc sine transformation before analysis. The critical difference (CD) was calculated at 5 per cent (P=0.05) probability level and wherever F value is non-significant it was denoted by NS.

3. RESULTS AND DISCUSSION

Germination is tested in the laboratory to assess the suitability of a seed lot for sowing and to compare the value of different seed lots, so as to provide a basis for seed trade. The capacity of the seeds to develop into a normal plant is then judged based on careful examination of the root and shoot growth. This is normally attempted by adopting a standard method of testing, prescribed for each species on the specified date. Temperature is considered to be the most important environmental factors thatregulate seed germination and seedling growth.

Seedgermination is subjected to precise regulation of environmental factors, which might promote or inhibit the expression of physiological parameters which ought to be reproducible as per ISTA (1999). The chemical reactions catalyzed by enzymes are highly sensitive to temperature. Low temperature can inhibit germination [11] and such seeds are also prone to chilling injury, while high temperature can moderate the seed germination.

In the present study, among the evaluated temperatures, irrespective of variety and lot, at low temperature of 15°C, the seeds fail to produce normal seedlings (produced only abnormal seedlings) indicating the non-suitability of this temperature range for germination of the tropical species (Table 1 and Plate 1). Tyagi and Sharma [12] in *Solanum viarum*; Carlson [13] and Blazich et al., [14] in Catharanthus reported that germination and growth reduced at low temperature for tropical species, but at 20°C the germination enhanced to 89%. According to Sumathi [15] the seeds of Karpokkarasi germinated faster and higher at high temperature of 30°C compared to low temperature (10°C). Higher abnormal seedlings (78.3%) was produced at low temperature of 15°C, however, 9.3,9.6 and 13.2% abnormal seedlings were recorded at temperature of 30°C, 25°C and20°C, respectively in bhendi seeds studied from this experiment (Table 1).

Eventhough, seeds of bhendi produced only abnormal seedlings at low temperature (15°C) , it could produce higher germination in high temperature range of 30°C (80.6%) followed by 25°C (79.8%), since the test species is of tropical origin, which might have required high temperature for germination (Plates 3 and 4). At temperature of 20°C, seeds showed germination of 73.4% which is higher than Minimum Seed Certification Standard of bhendi (65%) (Plate 2). Killer (1972) reported that temperature kinetics at the required range speeds up seed performance until the temperature becomes lethal for normal functioning of the physiological activities.

All the seedling quality parameters like, seedling root length (12.9 cm), shoot length (15.7 cm), dry matter production (0.327 g 10 seedlings^{-1}) and vigour index values (2195) were higher in 30°C temperature followed by 25°C which were

Table 1. Influence of seed testing temperature on germination and abnormal seedling of bhendi seeds

Parameters	Germination %					Abnormal seedling%				
Temperature	**15° C**	**20° C**	**25° C**	**30°C**	**Mean**	**15° C**	**20° C**	**25° C**	**30° C**	**Mean**
V_1L_1	0	73	79	84	59	78	13	9	9	27.25
V_1L_2	0	73	79	80	58	81	12	9	12	28.5
V_1L_3	0	73	81	80	58.5	79	13	9	9	27.5
V_1L_4	0	73	79	80	58.0	79	15	11	9	28.5
V_1L_5	0	73	81	80	58.5	81	14	11	10	29
V_2L_1	0	75	80	80	58.7	78	13	8	9	27
V_2L_2	0	73	79	80	58	76	13	9	9	26.75
V_2L_3	0	73	79	80	58	76	13	10	9	27
V_2L_4	0	73	80	79	58	76	14	10	8	27
V_2L_5	0	75	81	83	59.75	79	12	10	9	27.5
Mean	0	73.4	79.8	80.6		78.3	13.2	9.6	9.3	
	V	T	VXT			V	T	VXT		
SEd	0.84	0.53	1.69			1.0	0.63	2.01		
CD (P=0.05)	1.67	1.06	3.35			1.99	1.26	3.99		

V1 – ArkaAnamika; V2 – CO4; L – Number of lots

Table 2. Influence of seed testing temperature on hard and dead seeds of bhendi

Parameters	Hard seed %					Dead seed%				
Temperature	**15° C**	**20° C**	**25° C**	**30°C**	**Mean**	**15° C**	**20° C**	**25° C**	**30°C**	**Mean**
V_1L_1	0	0	0	0	0	22	14	12	7	13.75
V_1L_2	0	0	0	0	0	19	13	12	8	13
V_1L_3	0	0	0	0	0	21	14	10	11	14
V_1L_4	0	0	0	0	0	21	12	10	11	13.5
V_1L_5	0	0	0	0	0	19	13	8	10	12.5
V_2L_1	0	0	0	0	0	22	12	12	11	14.25
V_2L_2	0	0	0	0	0	24	14	12	11	15.25
V_2L_3	0	0	0	0	0	24	14	11	11	15
V_2L_4	0	0	0	0	0	24	13	10	13	15
V_2L_5	0	0	0	0	0	21	15	9	8	13.25
Mean	0	0	0	0		21.7	13.4	10.6	10.1	
	V	T	VXT			V	T	VXT		
SEd	0	0	0			1.36	0.86	2.72		
CD (P=0.05)	0	0	0			2.69	1.70	5.39		

V1 – ArkaAnamika; L – Number of lotsV2 – CO4

on par with each other, while it was the minimum in 20°C temperature. Since none the seedling showed normal seedling which is taken for calculating germination per cent in the temperature regime of 15°C, seedling length, vigour index and dry matter production could not be taken. This study is inconformity with the results of Blazich et al. [13] who found that germination was suppressed at 15°Cor night temperature in Catharanthus seeds, while the temperature above 20°C promoted germination of seeds irrespective of presence of light. Bhendi seeds produced the lengthiest root and shoot at the temperature of 30°C followed by 25°C, while the shortest root and shoot was noted in 20°C temperature (Table 3).

Nil hard seeds were recorded at all the temperature regimes studied for all the lots of both the varieties of ArkaAnamika and CO4. However, the dead seed observed was varying with different temperatures. Higher percentage of dead seeds (21.7%) was found when bhendi seeds were germinated at low temperature of 15°C (Table 3). Similar results were observed in shankhapushpi [16] seeds by Shobharani [17], who observed higher values for speed of germination, germination, seedling length, dry matter production and vigour index values in 30°C constant temperature followed by 25°C. Due to chilling injury the seeds might have died in low temperature. When the seed testing temperature increases, the dead seed percentage get

Table 3. Influence of seed testing temperature on root and shoot length of bhendi

Parameters	Root length (cm)					Shoot length (cm)				
Temperature	**15°C**	**20° C**	**25° C**	**30°C**	**Mean**	**15° C**	**20° C**	**25° C**	**30°C**	**Mean**
V_1L_1	0	7.4	12.7	13.6	8.4	0	10.7	14.5	17.4	10.6
V_1L_2	0	8.4	13.1	13.3	8.7	0	11.5	15.1	16.5	10.8
V_1L_3	0	7.3	12.8	13.8	8.4	0	11	14.6	16.2	10.4
V_1L_4	0	7.3	12.8	13.4	8.4	0	10.9	14.9	17.2	10.7
V_1L_5	0	7.7	13.1	13.6	8.6	0	10.9	15.0	17.0	10.7
V_2L_1	0	9.1	12.0	10.9	8.0	0	10.2	11.5	14.3	9.0
V_2L_2	0	9.4	11.9	10.9	8.0	0	10.4	11.7	14.5	9.1
V_2L_3	0	9.3	12.1	13.1	8.6	0	10.3	11.6	14.6	9.1
V_2L_4	0	9.5	12.0	13.1	8.6	0	10.2	11.7	15.7	9.1
V_2L_5	0	9.7	12.2	13.0	8.7	0	10.5	11.5	15.0	9.2
Mean	0	8.5	12.5	12.9		0	10.7	13.24	15.7	
	V	T	VXT			V	T	VXT		
SEd	0.204	0.12	0.40			0.17	0.11	0.34		
CD (P=0.05)	0.40	0.25	0.81			0.34	0.21	0.69		

V1 – Arka Anamika; V2 – CO4; L - Number of lots

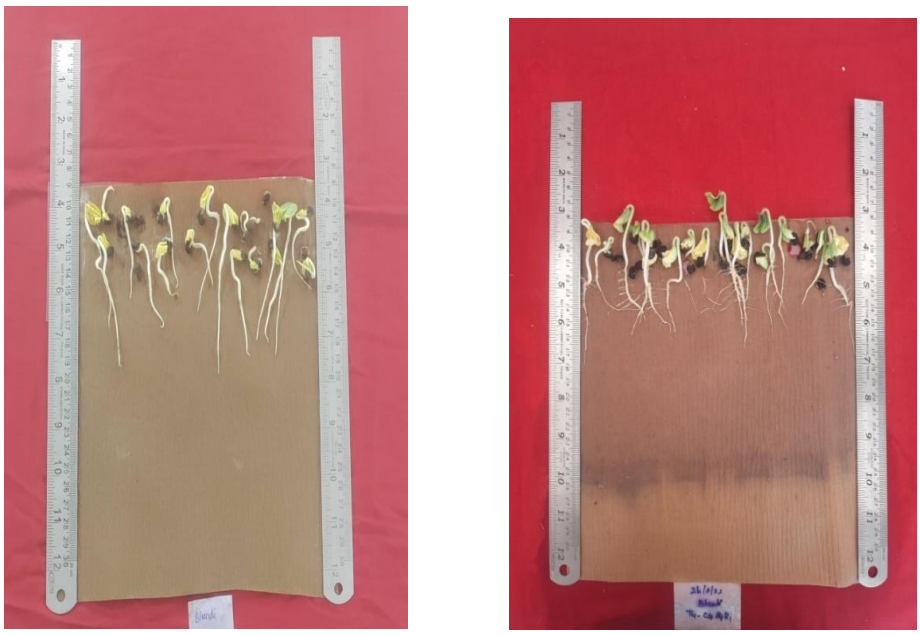
Table 4. Influence of seed testing temperature on Vigour index and dry matter production of bhendi

Parameters	Vigour Index					Dry matter production (g per 10 seedlings)				
Temperature	**15° C**	**20° C**	**25° C**	**30°C**	**Mean**	**15° C**	**20° C**	**25° C**	**30° C**	**Mean**
V_1L_1	0	1313	2069	2364	1436	0	0.292	0.320	0.326	0.235
V_1L_2	0	1456	2093	2238	1447	0	0.291	0.323	0.325	0.234
V_1L_3	0	1345	2087	2305	1434	0	0.292	0.327	0.327	0.237
V_1L_4	0	1335	2032	2265	1408	0	0.295	0.323	0.327	0.236
V_1L_5	0	1362	2138	2362	1466	0	0.287	0.317	0.326	0.234
V_2L_1	0	1457	1836	1925	1305	0	0.291	0.316	0.331	0.237
V_2L_2	0	1449	1826	1959	1308	0	0.292	0.326	0.323	0.236
V_2L_3	0	1436	1784	2196	1354	0	0.289	0.315	0.33	0.236
V_2L_4	0	1439	1808	2180	1357	0	0.291	0.315	0.326	0.233
V_2L_5	0	1518	1827	2157	1375	0	0.288	0.311	0.332	0.234
Mean	0	1411	1950	2195		0	0.291	0.319	0.327	
	V	T	VXT			V	T	VXT		
SEd	34.72	21.96	69.45			0.002	0.001	0.005		
CD (P=0.05)	68.76	43.48	137.52			0.004	0.002	0.009		

V_1- Arka Anamika; V_2 – CO4; L – No of Lots

decreased in all the seed lots of both varieties. The minimum dead seed was recorded in 30°C (10.1%) followed by 25°C (10.6%), whereas maximum was observed in the low temperature of 15°C (13.4%).

Seed vigour index (VI) is a widely accepted measure of seed and seedling vigour of a particular seed lot [18]. At the temperature of 30°C followed by 25°C, the computed vigour index and the seedling dry weight were maximum, and the minimum was found in the temperature of 20°C (Table 4). These results showed that the bhendi seed could produce vigourous seedlings at high temperature.



CO4 **Arka Anamika**

Plate 1. Bhendi seed germination at 15°C

CO4 **Arka Anamika**

Plate 2. Bhendi seed germination @ 20˚C

CO4 **Arka Anamika**

Plate 3. Bhendi seed germination @ 25 C

CO4 **Arka Anamika**

Plate 4. Bhendi seed germination @ 30°C

4. CONCLUSION

Therefore, from this study, it could be inferred that the seed testing temperature suitable for bhendi seed germination is 30°C or 25°C constant temperature. Low temperature (15°C) is not suitable for bhendi seed testing, since the normal seedlings were not produced at this temperature.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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