

## Germination and Seeding Growth of Soybean Varieties in Response to Temperature

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**Abstract** Seed development is a temperature-sensitive process that is much more vulnerable than vegetative tissues to abiotic stresses. The physiological process of germination depends on several environmental factors such as temperature, water potential, light and nutrients. In the present study the effect of different temperatures ranges (15°C to 40°C) on the germination and seedling growth of soybean varieties (BSS-2 and JS-335) has been compared. The optimal temperature of germination appears to be between 25°C to 30°C for both the varieties. The maximal temperature stood at 35°C as there was complete inhibition at 40°C. JS-335 appeared more temperature tolerant as compared to the BSS-2.

**Keywords** Germination, Seedling growth, Soybean, Temperature.

### Introduction

Temperature is an important environmental regulator of seed germination. Temperature affects the percentage of seeds that germinate and the rate of germination. Seeds kept at higher temperatures are more likely to deteriorate and not germinate. High and low stress temperatures during seed germination and seedling development limit total germination and the rate of germination and growth. All seeds have optimal temperature ranges for germination. Temperature affects cellular metabolic and growth rates.

Successful growth and establishment of plants considerably depends on optimum germination. Germination is a crucial stage in the life cycle of plants and tends to be highly unpredictable over space and time. Huang et al. [1], Sugahara and Takari [2] and other workers also reported that environmental factors such as temperature, salinity, light and soil moisture simultaneously influence germination. According to Elgi et al. [3] temperature is a major limiting factor affecting germination in the arid and semiarid areas. He found that initial establishment of a plant species in high temperature area is related to germination response of seeds to temperature and early establishment usually determines if a population will survive to maturity.

Al-Ahmadi and Kafi [4] stated that cardinal temperatures (minimum, optimum and maximum) determine the range of temperatures at which a par-

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ticular plant seeds can germinate. Species dispersion area, suitable time and place for growing can be evaluated by knowing cardinal. Soybean is an important *kharif* pulse crop. In the present study the germinability of two varieties of soybean (BSS-2 and JS-335) with a view to understanding the germination percentage and early seedling growth under different temperature ranges has been compared.

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### Materials and Methods

Germination experiments were conducted in sterilized petridishes of 9 cm containing thin cotton pads, covered over by filter papers circles. Distilled water was used as a soaking medium for seeds and filter circles. Seeds of two varieties of soybean (BSS-2 and Js-335) of homogenous size were selected and surface sterilized with 2% solution of sodium hypochlorite (for 5 minutes) and then thoroughly washed with distilled water. Three replicates, each with 10 seeds were taken for each treatment. For finding out the temperature optima, seeds, were tested for their germinability at 15°C, 20°C, 25°C, 30°C, 35°C and 40°C by placing the replicates in incubators maintained at aforesaid temperatures. The seeds with visible emergence of radicles were taken as germinated and such seeds were scored every 24 h to 240 h after soaking. Mean germination percentage was calculated on the basis of mean replicates. Length of radicles and hypocotyls were measured separately in cm after 96 h. Radicles and hypocotyls along with cotyledons were weighed on digital balance for weights.

### Results and Discussion

As can be seen in Table 1 seeds started germinating at 15°C onwards with 85 and 80% of seeds with visible radicles of BSS-2 and JS -335 respectively with initial time lag of 24 h . At 20°C, 25°C and 30°C the

**Table 1.** Effect of different temperatures on the germination % and early seedling growth of soybean varieties (BSS-2 and JS-335) germination %.

Treatments	BSS-2	JS-335
15°C	85	80
20°C	90	85
25°C	95	90
30°C	100	100
35°C	85	80
40°C	–	–

**Table 1.** Continued.

Treatments	Seedling length after 96 h (in cm)					
	BSS-2			JS-335		
R	H	T	R	H	T	
15°C	0.388	1.660	2.048	1.228	1.173	2.401
20°C	0.922	2.567	3.489	2.547	1.574	3.761
25°C	2.080	1.335	3.415	2.201	3.079	5.274
30°C	4.106	5.467	9.573	5.723	6.139	11.862
35°C	1.817	2.283	3.930	4.067	2.242	6.309
40°C	–	–	–	–	–	–

**Table 1.** Continued.

Treatments	Seedling fresh weight after 96 h (in mg)					
	BSS-2			JS-335		
R	H	T	R	H	T	
15°C	74	2242	2316	66	1640	1706
20°C	264	2563	2827	185	1974	2159
25°C	373	2747	3120	147	2689	2836
30°C	513	3897	4410	567	4040	4607
35°C	204	996	1200	369	1141	1510
40°C	–	–	–	–	–	–

**Table 1.** Continued.

Treatments	Seedling length after 144 h (in cm)					
	BSS-2			JS-335		
R	H	T	R	H	T	
15°C	1.022	2.007	3.029	2.168	2.060	4.228
20°C	1.703	2.466	4.169	3.311	3.362	6.673
25°C	3.677	2.574	6.251	5.466	4.501	9.967
30°C	5.056	6.362	11.418	6.892	7.727	14.919
35°C	2.656	3.448	6.104	4.907	3.062	7.969
40°C	–	–	–	–	–	–

**Table 1.** Continued.

Treat- ments	Seedling fresh weight after 144h (in mg)					
	BSS-2			JS-335		
	R	H	T	R	H	T
15°C	160	2710	2870	180	2653	2832
20°C	416	3026	3442	343	3045	3388
25°C	523	3676	4199	462	3750	4212
30°C	546	4233	4779	636	5012	5648
35°C	183	2911	3094	204	2764	2968
40°C	–	–	–	–	–	–

percentage increased upto 100% of germinated seeds in the two varieties. Further, the initial time lag was reduced to 12 h. However at 35°C the germination rate declined with complete inhibition at 40°C. At higher temperature also, the initial time lag remains 12 h. All the seeds of each variety were radicals within a span of 12 h at 30°C in contrast to the longer periods at other temperatures. Length and fresh weight of seedlings of both varieties was maximum at 30°C.

From the results it is evident that all the two varieties can germinate from 15°C onwards. The optimal temperature of germination appears to be between 25°C to 30°C. The maximal temperature stood at 35°C as there was complete inhibition at 40°C. Gorai and Neffati [5] and Tlig et al. [6] also reported similar situation. The varietal differences with regard to threshold of temperature requirements did not vary much. However, the differences owing to

variability in the radical length indicated that JS-335 tolerated higher temperature as compared to the BSS-2 varieties. In optimal temperature of 30°C of some plants have been reported by many workers like Beena and Jayaram [7], Gairola et al. [8] and Saba et al. [9].

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