

Response of chickpea seed germination to varying temperatures

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ABSTRACT

Fifteen cultivars of chickpea were evaluated by having vigour test viz. percent germination, shoot length, root length, dry matter per seedling, vigour index and growth rate index. These were determined in the laboratory of National Seed Project centered at Haryana Agricultural University, Hisar during 2005. The germination was below 90 per cent at 35°C temperature in HC-3, HK-1, HC-1, H-208, Gora Hisari and H Gaurav cultivars. At 25°C temperature, germination rate index was above 13.0 in most of the cultivars. Seed vigor (SG1) was maximum around 25°C. It is concluded that temperature had a strong influence on the germination and seed vigour of different chickpea cultivars.

Key words: Chickpea cultivars, germination rate index, seed vigour test, optimum temperature.

Seed vigour refers to the ability of seed to germinate, emerge, and produce a good crop under a wide range of environmental conditions. Successful stand establishment of any plant species depends on utilizing the optimum temperature for generation and initial root growth. Most of the plant species respond at an optimum temperature for seed germination above or below which seed germination is reduced (Quinlivan *et al.*, 1987), Brar *et al.* (1991) reported that seed germination percentage of common vetch (*v. Savita*) and hairy vetch (*v. Villosa*) was higher at 15 and 20°C than at 10, 25 or 30°C. Brar *et al.* (1990) determined that optimum temperature for growth of main root axis in 'chaba white' common vetch and 'wood ford' big flower vetch was between 15 and 25°C, whereas root length of 'vanguard' common vetch and hairy vetch were not affected by temperature.

Seed germination in chickpea (*Cicer arietinum*) is one of the sensitive phases to chilling/cold temperature. Soil temperature <10°C may substantially reduce seed germination and seedling establishment especially in kabuli genotypes due to large seed size and thin seed coat (Chen *et al.* 1983). Peacock *et al.* (1990) demonstrated that high temperature (above 45°C) around the shoot meristem of sorghum seedlings inhibited seedling growth even when moisture was not limiting. Results of germination studies made at constant temperature do not necessarily reflect field germination where soil temperature at seed depth fluctuates widely during the day (Singh *et al.*, 1998).

Scanty information is available on seed germination and root growth of chickpea cultivars. So this study was designed to determine optimum temperature for seed germination, growth rate, vigour testing and to establish relationship between temperature and these seed characters

in different chickpea cultivars.

MATERIAL AND METHODS

Fifteen diverse cultivars of chickpea were evaluated by having vigour test viz. percent germination, shoot length, root length, dry matter per seedling, Vigour index and growth rate index. These were determined in the laboratory of National Seed Project centered at Haryana Agricultural University, Hisar during 2005.

Three replications of 25 seeds each were planted according to standard germination test for seven days at 20, 25, 30 and 35°C temperatures, and 5 seedlings each were selected randomly from each replication and root and shoot lengths were measured. These five seedlings were oven dried and dry matter was determined. For average vigour index calculations shoot length, root length and dry matter per seedling were used in two different formulae (AOSA, 1983). The formulae used in study were:

Germination Percentage (TGP) = (Seedlings emerged/Seeds sown) x 100

Germination Rate Index (GRI) = % germination/Total No. of days to germination

Seed Vigour (SG1) = Standard Germination x (Shoot+Root) length

(SG2) = Standard germination x Dry matter per seedling

RESULTS AND CONCLUSIONS

It was observed under laboratory experiments (Table 1), that the total germination percentage (TGP) at 35°C was

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Table 1: Total germination percentage (TGP), germination rate index (GRI) in chickpea cultivars

Sr #	Cultivars	TGP				GRI			
		20 ⁰ C	25 ⁰ C	30 ⁰ C	35 ⁰ C	20 ⁰ C	25 ⁰ C	30 ⁰ C	35 ⁰ C
1.	HC-3	74	99	94	79	12.3	14.1	13.4	11.3
2.	PUSA 256	83	98	91	91	11.9	14.0	13.0	13.0
3.	HK-1	85	94	82	65	12.1	13.4	11.7	9.3
4.	CSG 8962	96	96	85	96	13.7	13.7	12.1	13.7
5.	HC-1	76	98	94	81	10.9	14.0	13.4	11.6
6.	HC-5	97	98	98	100	13.9	14.0	14.0	14.3
7.	PDG 84-16	83	91	89	93	11.9	13.0	12.7	13.3
8.	ICCV-9001	95	92	90	97	13.6	13.1	12.9	13.9
9.	ICCV-9516	98	99	88	92	14.0	14.1	12.6	13.1
10.	C-235	85	97	97	100	12.1	13.9	13.9	14.3
11.	ICCV-96029	85	90	91	96	12.1	12.9	13.0	13.7
12.	H 208	91	87	95	71	13.0	12.4	13.6	10.1
13.	ICCV-3127	85	91	91	81	12.1	13.0	13.0	11.6
14.	Gora Hisari	96	80	86	55	13.7	11.4	12.3	7.9
15.	H Gaurav	87	92	71	93	12.4	13.1	10.1	13.3

Table 2: Seed vigour in various chickpea cultivars at different temperatures

Sr #	Cultivars	SG1 = Std Germination x (Shoot+Root) length				SG2 = Std Germination x DM per seedling			
		20 ⁰ C	25 ⁰ C	30 ⁰ C	35 ⁰ C	20 ⁰ C	25 ⁰ C	30 ⁰ C	35 ⁰ C
1.	HC-3	1551	3227	3140	1888	1.2	3.3	3.8	3.1
2.	PUSA 256	1411	3606	3185	2166	0.9	2.5	2.8	1.7
3.	HK-1	1522	3431	2362	1495	2.1	3.6	1.8	1.9
4.	CSG 8962	1526	3408	2431	2477	1.5	2.7	1.6	2.1
5.	HC-1	1224	2607	3121	2195	1.5	1.1	2.5	1.4
6.	HC-5	1610	3479	3401	2630	1.5	2.3	3.0	1.5
7.	PDG 84-16	1453	2439	2563	2372	1.2	0.7	2.5	2.0
8.	ICCV-9001	1948	3386	2799	2842	2.1	2.6	1.5	2.1
9.	ICCV-9516	1911	3762	2596	2659	1.9	2.7	1.8	2.0
10.	C-235	1632	2997	3463	2700	1.4	1.6	2.3	2.4
11.	ICC-96029	1573	2592	3249	2736	1.5	1.0	1.4	2.0
12.	H 208	1492	2384	3344	1441	1.9	1.2	4.3	2.2
13.	ICCV-3127	1785	2512	3094	1717	2.2	0.9	2.5	1.6
14.	Gora Hisari	1651	2552	2907	1095	1.6	2.3	3.8	1.1
15.	H Gaurav	1296	3036	1633	2111	1.6	4.5	1.2	2.9

below 90 per cent in HC-3, HK-1, HC-1, H-208, Gora Hisari and H Gaurav cultivars. At 30°C temperature, germination recorded was below 90 per cent in HK-1, CSG 8962, PDG 84-16, ICCV-9616, Gora Hisari and H Gaurav. The germination was also below 90 per cent in H 208 and Gora Hisari cultivars at 25°C temperature. Similarly, at 20°C temperature, the germination was below 90 per cent in HC-3, PUSA 256, HK-1, HC-1, PDG 84-16, C-235, ICCV-96029, ICCV 3127 and H Gaurav cultivars.

Germination rate index (GRI) at 20°C temperature recorded was above 13.0 in CSG-8962, HC-5, ICCV-9001, ICCV-9516, H 208 and Gora Hisari cultivars. At 25°C temperature, the GRI was above 13.0 in most of the cultivars except ICCV-96029, H 208 and Gora Hisari cultivars. At 30°C temperature, GRI was above 13.0 in HC-3, PUSA 256, HC-1, HC-5, C-235, ICCV-96029, H 208 and ICCV-3127

cultivars. At 35°C temperature, GRI was above 13.0 in PUSA 256, CSG 8962, HC-5, PDG 84-16, ICCV-9001 & ICCV-9516, C-235, ICC-96029 and H Gaurav cultivars. The variation in TGP and GRI may attributed to different varietal characteristics and their performance under varying temperatures. The results were in close conformity by earlier studies done by Singh *et al.* (1999) in *Brassica spp.*

Among all the cultivars, the seed vigour (SG1) ranged between 1296 to 1948 at 20°C, 2384 to 3606 at 25°C, 1633 to 3463 at 30°C and 1095 to 2842 at 35°C, respectively (Table 2). The maximum SG1 was observed in ICCV-9001 at 20°C, in PUSA 256 at 25°C, in C-235 at 30°C and in ICCV-9001 at 35°C, respectively. The seed vigour (SG2) among all the cultivars ranged between 0.9 to 2.2 at 20°C, 0.7 to 4.5 at 25°C, 1.2 to 4.3 at 30°C, and 1.1 to 3.1 at 35°C, respectively. The maximum SG2 (Table 2) was observed in ICCV-3127

at 20°C, in H Gaurav at 25°C, in HC-3 and Gora Hisari at 30°C and in HC-3 at 35°C, respectively. The results were in close conformity with earlier studies done by Singh *et al.* (1999) in *Brassica spp.*

It may be concluded that sowing temperature and varietal characteristics had a strong influence on the germination and seedling establishment of different chickpea cultivars. Seed vigour in relation to temperature is one of the important determinants in chickpea seedling establishment after germination.

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