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## Determination of the optimum temperature for germination and seed vigour of hybrid tomato

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### Abstract

An experiment was conducted to assess the effect of temperature variation (20°C, 25°C and 30°C) in five parents (Pusa Rohini, Azad Type-2, KS-7, KS-229 and Azad Type-3) and their 10 hybrids (Pusa Rohini x Azad Type-2, Pusa Rohini x KS-7, Pusa Rohini x KS-229, Pusa Rohini x Azad Type-3, Azad Type-2 x KS-s, Azad Type-2 x KS-229, Azad Type-2 x Azad Type-3, KS-7 x KS-229, KS-7 x Azad Type-3 and KS-229 x Azad Type-3) on quality seed parameters, at seed testing laboratory, Department of Seed Science & Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, during 2011-12 & 2012-13. Study revealed that among the parents, Pusa Rohini and among the hybrids, Pusa Rohini x Azad Type-2 combination at 20°C was found to be over all best for exhibiting highest germination, seedling dry weight and vigour index.

**Keywords:** Different temperature, germination, vigour, tomato.

### Introduction

Tomato, an important vegetable crop, is grown for fresh market as well as for processing purpose. Quality seed alone can significant boost up its productivity. Production of quality seed is possible only under favorable climatic conditions such as temperature and relative humidity. The temperature especially at the time of flowering and fruit setting finally leads to production of quality seed. Any biotic and abiotic stresses during this period, adversely affect the quality of seed. The present investigation was carried out to assess the effect of different temperatures for germination and seed vigour in tomato.

### Materials and Methods

The experiment was accomplished in Seed Testing Laboratory in the Department of Seed Science & Technology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur during the two consecutive years 2011-12 and 2012-13. Laboratory experiment was analyzed statistically by adopting CRD (complete randomized design). Freshly harvested Seeds of five tomato varieties procured from Department of Vegetable Science, Kalyanpur, Kanpur were sown in 2011-12 in crossing block separately and partial diallel crosses were made. The seeds harvested from crosses and parents in both the years were subjected to laboratory analysis in three different temperatures (20 °C, 25 °C and 30 °C) ranges in four replications based on ISTA rules. Observations were recorded on seed quality parameters. 100 seeds from each fifteen genotypes (5 parents and 10 crosses) were put in between paper method in each temperature levels. The evaluation of normal and abnormal seedlings and dead seeds were done on 14<sup>th</sup> days. Vigour index was calculated using the following formula suggested by Abdul Baki and Anderson (1973) [1] and expressed in whole number. Vigour index = germination % x total length of seedling (cm.). Finally, data were subjected to statistical analysis for further interpretation and conclusion.

### Results and Discussion

The computation of ANOVA over the different temperature ranges, revealed the significant variation among temperature in respect of germination percentage, root length, seedling dry weight and vigour index. (Table-1)

**Table 1:** Analysis of variance for various seed quality parameters in tomato

Source	D.F.	Germination (%)	Root Length (Cm)	Shoot Length (Cm)	Seedling Dry Weight (Mg)	Vigour Index
Genotype (G)	14	77.91*	22.43*	7.01*	0.01*	268576.41*
Different Temperature(T)	2	330.27*	158.66*	52.54*	0.03*	1976084.31*
G x T	28	14.37*	6.54*	1.88*	0.002*	60617.43*
Error	135	3.47*	1.70*	0.43*	0.001*	24646.70*

\*Significant at 0.1 % level.

**Table 2:** Pooled mean performance of parents and crossed seed with respect to germination (%), root length (cm) and shoot length (cm) in different temperature ranges in tomato.

Parents & Crosses	GERMINATION (%)				ROOT LENGTH (CM)				SHOOT LENGTH (CM)			
	T1	T2	T3	Mean	T1	T2	T3	Mean	T1	T2	T3	Mean
Pusa Rohini	82.20	79.35	74.51	78.68	6.69	5.81	5.33	5.94	8.82	12.07	8.73	9.87
Azad Type-2	78.88	79.14	76.42	78.15	6.07	6.34	5.97	6.13	10.72	10.05	7.59	9.45
KS-7	79.13	77.96	73.43	76.84	6.60	6.21	4.91	5.91	10.62	8.97	8.31	9.30
KS-229	75.81	74.23	70.30	73.45	5.76	5.92	4.57	5.42	8.68	8.19	8.35	8.40
Azad Type-3	78.12	76.82	75.31	76.75	7.34	5.52	4.25	5.70	8.28	8.90	8.10	8.42
Pusa Rohini x Azad Type-2	82.45	81.32	80.43	81.40	8.36	8.04	7.41	7.94	12.37	9.79	9.73	10.63
Pusa Rohini x KS-7	83.67	82.06	76.87	78.44	9.13	8.02	6.18	7.77	8.97	10.83	10.01	9.94
Pusa Rohini x KS-229	80.70	78.31	70.89	76.63	7.51	7.86	4.67	6.68	11.08	11.41	8.00	10.16
Pusa Rohini x Azad Type-3	80.05	79.83	76.07	78.65	7.20	7.46	4.40	6.35	10.79	10.08	9.95	10.27
Azad Type-2 x KS-7	80.91	83.12	79.19	81.07	6.69	7.48	6.04	6.74	11.11	8.89	9.11	9.70
Azad Type-2 x KS-229	82.60	80.22	74.51	79.11	9.39	7.57	5.86	7.61	10.59	10.94	10.17	10.56
Azad Type-2 x Azad Type-3	78.10	79.14	74.72	77.23	7.31	7.27	5.06	6.65	10.13	10.38	8.84	9.77
KS-7 x KS-229	77.37	76.78	72.61	75.59	7.25	6.30	6.84	6.80	8.38	9.26	7.77	8.47
KS-7 x Azad Type-3	76.84	75.82	71.50	74.72	7.69	7.35	6.54	7.19	10.63	9.38	8.58	9.53
KS-229 x Azad Type-3	78.73	76.66	74.29	76.56	7.56	6.68	5.83	6.69	9.37	8.68	8.61	8.88
Mean	79.70	78.70	74.73		7.37	6.92	5.59		10.03	9.85	8.79	
	G	T	G x T		T	G	G x T		G	T	G x T	
C.D. at 5 %	0.51	0.23	0.89		0.07	0.16	0.29		0.23	0.10	0.40	

**Table 3:** Pooled mean performance of parents and crossed seed with respect to seedling dry weight (mg) and vigour index in different temperature ranges dates in tomato

Parents & Crosses	Seedling Dry Weight (mg)				VIGOUR INDEX			
	T1	T2	T3	Mean	T1	T2	T3	Mean
Pusa Rohini	0.18	0.19	0.14	0.17	1811.75	1436.41	1306.05	1518.07
Azad Type-2	0.21	0.19	0.18	0.19	1554.77	1642.61	1282.22	1493.20
KS-7	0.14	0.14	0.16	0.14	1490.22	1621.62	1214.97	1442.27
KS-229	0.21	0.15	0.15	0.17	1292.77	1372.87	1146.20	1270.61
Azad Type-3	0.15	0.15	0.14	0.15	1539.46	1321.84	1189.42	1350.24
Pusa Rohini x Azad Type-2	0.31	0.22	0.21	0.24	1781.78	1984.03	1667.72	1811.17
Pusa Rohini x KS-7	0.29	0.23	0.21	0.24	1958.17	1678.85	1535.92	1724.31
Pusa Rohini x KS-229	0.26	0.20	0.15	0.20	1815.28	1844.77	1132.26	1597.44
Pusa Rohini x Azad Type-3	0.19	0.21	0.17	0.19	1673.99	1770.90	1352.45	1599.11
Azad Type-2 x KS-7	0.27	0.25	0.21	0.24	1536.62	1812.92	1462.15	1603.89
Azad Type-2 x KS-229	0.27	0.24	0.22	0.24	1979.91	1793.97	1475.86	1749.91
Azad Type-2 x Azad Type-3	0.21	0.17	0.22	0.20	1698.15	1656.78	1261.17	1638.70
KS-7 x KS-229	0.18	0.17	0.16	0.17	1559.20	1378.78	1312.35	1416.77
KS-7 x Azad Type-3	0.24	0.16	0.18	0.19	1625.14	1722.27	1379.62	1575.67
KS-229 x Azad Type-3	0.25	0.24	0.18	0.22	1529.31	1540.41	1279.89	1455.87
Mean	0.22	0.19	0.18		1656.43	1638.60	1334.41	
	G	T	G x T		T	G	G x T	
C.D. at 5 %	0.01	0.008	0.02		18.66	41.74	72.29	

The quality of seed lot is basically pre determined by two major quality seed attributes, germination percentage and vigour index. Present investigation revealed a good deal of significant variation among genotypes for germination (73.45%-78.68% & 1270.61-1518.07) and vigour (74.22% - 81.40% & 1416.77-1811.17) in parents and their combinations respectively. The variation may be due to diverse genetic makeup and better combining ability as well as heritability of genotypes.

Pusa Rohini and its combination with Azad Type-2 was found to be best both in scoring the highest seed germination (78.68% & 81.40%) and vigour (1518.07 & 1811.17)

respectively. It may also be due to genetic architecture of genotype and better heritability for enhancing the seed quality attributes in their respective hybrid Azad type -2 performed at par for germination as well as vigour but its combination with KS-7 and KS-229 for germination and vigour respectively.

Highest root length (6.13cm & 7.94cm) and shoot length (9.45cm& 10.63cm) was recorded with Azad type -2and its combination with Pusa rohini respectively.

Highest seedling dry weight (0.19 mg) was scored with Azad type-2 but among the all combinations, four combinations (Pusa rohini X Azad type-2, Pusa rohini X KS-7, Azad type-2, X KS-7 and Azad type-2X KS-229) scored the similar

seedling dry weight (0.24mg)

Likewise, significant variation in performance of temperature ranges for all the quality seed parameters was observed, it reflects the probabilities in improving the quality seed traits.

Highest germination (79.70% ), root length (7.37cm), shoot length (10.03cm), seedling dry weight (0.22mg) and vigour index (1656.43) was recorded with 20°C temperature followed by 25°C and 30°C, may be due to that 20°C temp. is more conducive for accelerating the all enzymatic activities for making unavailable stored food material in to available form and speedy migration to radicle and plumule.

Interaction between G x T played a significant contribution in improving the quality traits under study. Among the parents, Pusa rohini for germination (82.20%) and vigour index (1811.75), Azad type-3 for root length (7.34 cm), Azad type-2 for shoot length (10.72cm) and seedling dry weight along with KS-229 (0.21mg). Among the different combinations, Pusa rohini x KS-7 for germination (83.07%) and root length (9.13cm), Pusa rohini x Azad type-2 for Shoot length (12.37cm), Pusa rohini x Azad type-2 for seedling dry weight (0.31mg) and Azad type-2 x KS -229 for vigour index scored over all highest value of respective traits.

### Conclusion

It seems from the study that 20 °C temperature is most conducive for getting highest germination, vigour index along with other quality seed parameters. Whereas, performances of genotypes are concerned, Pusa rohini was found best parent which may be used in further crossing.

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