

# High Temperature Inhibits Germination of Jalapeno and Cayenne Pepper

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**Abstract.** The germination of five commercial cultivars of jalapeno and cayenne pepper were tested to determine cultivar response of *Capsicum annuum* L. to supra-optimal temperatures. Two seedlots of 'Cayenne, Large Red Thick', 'Ole', 'Jalapeno M', 'Mitla', and 'Tam Veracruz' were evaluated on a thermogradient table at temperatures of 20, 25, 30, 35, and 40 °C. Percent germination and time to 50% of final germination (T<sub>50</sub>) were calculated. All cultivars exhibited thermodormancy, but the degree of inhibition varied within temperature and cultivar. No cultivar had >1.0% germination at 40 °C. Generally, the T<sub>50</sub> varied among cultivars, but not among temperatures within a cultivar (T<sub>50</sub> at 40 °C was not measured). Cultivar selection should be considered when growing fall transplants in Florida.

In the southern United States, thousands of acres of peppers are planted commercially in the fall and spring. Fall production accounts for much of the acreage of jalapeno peppers. However, seed for fall transplants is sown when summer greenhouse temperatures can reach 40 to 45 °C for 6 h or more (Vavrina, 1994). This is far above the optimum temperature (29 °C) for pepper germination (Maynard and Hochmuth,

1997). Shade cloth and tray-top dressings of vermiculite or perlite to cool the germination medium may not prevent inhibited or erratic germination. Erratic germination causes various production schedule complications and often reduces overall stand establishment.

The inability to germinate at higher than optimal temperatures is attributed to a condition called thermoinhibition. Tomato (*Lycopersicon esculentum* Mill.) seeds do not germinate at high temperatures (=35 °C), but do germinate after temperature is reduced to 25 °C or 30 °C (Abebe, 1993). Thermoinhibition also occurs in other vegetable seeds, such as celery [*Apium graveolens* L. *dulce* (Mill) Pers.] (Biddington 1981), lettuce (*Lactuca sativa* L.) (Borthwick and Robbins, 1928; Khan, 1980/1981), and spinach (*Spinacia oleracea* L.) (Harrington, 1963; Leskovar et al., 1999). In lettuce, thermotolerance differs among cultivars (Damania, 1986; Gray, 1975; Thompson, 1979); this has been attributed to the degree of endo-β-mannanase activity in the seeds (Nascimento et al., 2000).

Pepper seed germination was improved under supra-optimal conditions if the seeds were first soaked in solutions of ethephon or gibberellic acid (GA<sub>3</sub>) (Carter and Stevens, 1998). However, priming incurs additional costs and time considerations. A knowledge of which cultivars can germinate under supra-optimal conditions might be a more acceptable approach for transplant producers. Germination does not necessarily equate with stand establishment, but defining whether poor stand establishment is due to inhibition of germination or poor seedling growth is a logical first step. The purpose of this study was to survey the effect of temperature on the germination of different cultivars of jalapeno and cayenne pepper (*Capsicum annuum* L.) used commercially in Florida.

**Seed sources.** Five commercial cultivars of cayenne or jalapeno pepper were chosen based on the ability to obtain two seedlots of each cultivar. Seeds of 'Ole' (15759-27420 and 15759-34420; Ferry Morse Seed Co., Modesto, Calif.); 'Jalapeno M' (057-014-1168 and 057-014-1188; PetoSeed Co., Saticoy, Calif.); 'Mitla' (007-104-1515 and 007-104-1516; PetoSeed Co.); 'TAM Veracruz' (057-674-1024 and 057-674-1027; PetoSeed Co.); and 'Cayenne, Large Red Thick' (1163 and 1169; PetoSeed Co.) were used. 'Ole' and 'Mitla' are F<sub>1</sub> hybrids while 'Jalapeno M', 'TAM Veracruz', and 'Cayenne, Large, Red Thick' are open-pollinated.

**Seed germination.** Germination temperatures of 20, 25, 30, 35, or 40 °C were maintained on a one-dimensional, linear thermo-gradient table (Van dok and De boer Machinefabriek b.v., Enkhuizen, The Netherlands). Four replicates of 25 seeds each were placed on two layers of filter paper (W&R Balston L. Genuine Whatman, England) in separate 9-cm-diameter petri dishes. The filter paper was wetted with 10 mL of distilled water. Evaporation rates at 35 °C and 40 °C required the addition of 4 mL H<sub>2</sub>O every 2 d for these two treatments. The four replicates of each of the 10 seedlots were completely randomized within each temperature treatment. The entire experiment was repeated twice.

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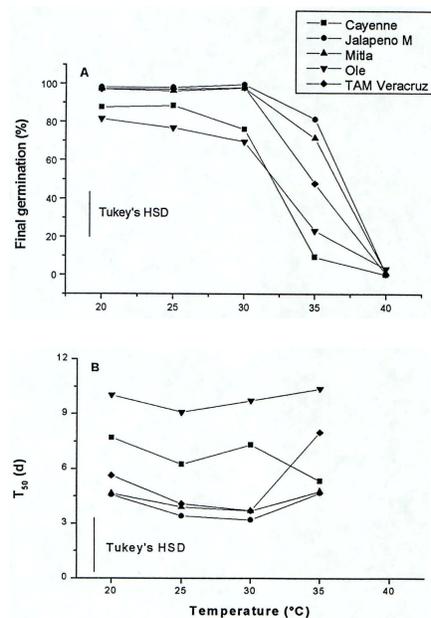
Germination was recorded daily until the remaining seeds began to deteriorate (16 d). A seed was considered germinated when the radicle had elongated =2 mm from the seed coat. Total percentage of germination and time to 50% of final germination ( $T_{50}$ ) were calculated. Statistical analysis and mean separation were calculated using SAS statistical software (SAS Institute, Cary, N.C.).

Differences between the two experiments were nonsignificant, so the data were combined in a pooled analysis. Mean square errors were calculated by hand, then an F test was performed using the appropriate degrees of freedom.

Germination of 'Jalapeno M', 'Mitla', and 'TAM Veracruz' was nearly 100% from 20 to 30 °C (Fig. 1A). At 35 °C, germination of 'TAM Veracruz' decreased to 48% while that of 'Jalapeno M' and 'Mitla' dropped to 82% and 72%, respectively. Germination of 'Cayenne, Large, Red Thick' and 'Ole' was below 25% at 35 °C. Germination of all cultivars was =1% % germination at 40 °C. The critical maximum (Harrington, 1963) for germination appeared to be between 30 and 35 °C. Germination of 'Ebano' had 95% germination at 35 °C, but again germination dropped to 1% at 40 °C (data not shown). Cultivar differences in germination response to temperature have been reported in lettuce (Perkins-Veazie and Cantliffe, 1984; Prusinski and Khan, 1990; Thompson et al., 1979) and spinach (Atherton and Farooque, 1983; Leskovar et al., 1999). Germination of 'Packman' broccoli (*Brassica oleracea* L., Botrytis group) decreased from 90% to 63% at 35 °C when the germination of this cultivar was tested at a range between 5 and 40 °C (Elson et al., 1992).

Germination differences were also evident between seedlots of the same cultivar (data not shown); however, making generalizations about seedlot differences is inappropriate when only two seedlots of each cultivar were tested. Since growers and seed producers expect consistency within a cultivar from season to season, seedlot variation should be noted. Demir (1992) showed that variation in pepper

seed quality resulted from differences in seed developmental age and storage conditions and that this could vary from one seedlot to another.



Temperature had little affect on the time to 50% of final germination for each of the five cultivars (Fig. 1B). Only in 'TAM Veracruz' did  $T_{50}$  increase between 30 and 35 °C. The  $T_{50}$  varied among cultivars from 4 to 10 d at temperatures between 20 and 35 °C; the  $T_{50}$  was not calculated for 40 °C, as germination percentages were =1% for all cultivars. Differences among seedlots of the same cultivar were nonsignificant (data not shown).

Cultivar differences in final germination was most pronounced at 35 °C. Therefore, growers should take this into consideration when choosing cultivars for fall transplants. However, no cultivar germinated well at temperatures higher than 35 °C Other methods of cooling the greenhouse, such as shading or the use of white seed flats (Vavrina, 1994), should also be considered.

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