Muskmelon Cultigens Evaluated for Low-temperature Germinability

Mark G. Hutton¹ and J. Brent Loy

Department of Plant Biology, University of New Hampshire, Durham, NH 03824

Additional index words. *Cucumis melo*, cold tolerance, plant introductions

Muskmelon (*Cucumis melo* L.) seed typically do not germinate in soils near or below 15C (Lorenz and Maynard, 1980), and seedlings exposed to ≤ 18 C show little growth and are susceptible to chilling injury (Hassell, 1979).

As a first step in a breeding program for improving cold tolerance, we evaluated three breeding lines, 40 commercial, open-pollinated cultivars, and 367 accessions from the U.S. Dept. of Agriculture Southern Regional Plant Introduction Station, Experiment, Ga., for capacity to germinate at 15C. Captant-treated seed were incubated in 25 $\times$ 100-mm plastic petri dishes lined with cellulose absorbent wadding (Curity #7057 Atlantic Healthcare, Westbrook, Maine) saturated with 12 ml of prechilled distilled water. Two replications, 10 seeds each, of each accession were incubated at 15 and 30C; germination counts were made at 48-h intervals for the duration of experiments (96 and 336 h for 30 and 15C, respectively). The following data were computed: A) mean hours to radicle emergence >3 mm (emergence index, EI); B) mean hours to hypocotyl elongation >1 mm (hypocotyl index, HI); C) mean hours to cotyledon expansion beyond the seedcoat (cotyledon index, CI); and D) root hair and lateral root development on a scale where 0 = no root hairs or lateral roots and 4 = well-developed root hairs and lateral roots. Germination indices were computed as follows (Loy and Evensen, 1979):

$$\text{Index} = \frac{S_1T_1 + S_2T_2 + \dots + S_nT_n}{S_1 + S_2 + \dots + S_n}$$

where S is the number of seeds reaching a particular stage of germination during time T (hours). Cultigens were classified as cold germinable if they met the following criteria at 15C: radicle emergence $>80\%$, EI ≤ 240 , HI ≤ 265 , CI ≤ 290 , based on comparative performance of a known cold-tolerant strain, Persian 202 (Nerson et al., 1982, obtained from H. Nerson). Cultigens with $<70\%$ radicle emergence at 30C were excluded from comparisons.

Cold germinable (CG) and non-cold germinable (NCG) selections were selfed and

S₁ seed were rescreened for cold germinability. All S₁ seed for comparison were harvested during the same season, obtained only from fully ripe fruit, fermented for 4 days, dried at 30C, and stored at room temperature for at least 4 months to remove any seed dormancy before germination experiments were started.

Frequency distributions for germination indices of muskmelon cultigens at 15C are shown in Fig. 1. About 90% of all cultigens, but only four of 37 commercial cultivars (Old Time Tennessee, Minnesota Midget, Far North, and Sweet Granite), showed some radicle emergence after 14 days at 15C. Seed from 59% of the plant introductions gave $\geq 80\%$ radicle emergence, but only 6.8% of those had a CI ≤ 290 . Using the cold-germinable criteria previously described, $\approx 5\%$ of all cultigens were classified as cold germinable. Also, degree of root hair and lateral root development at 15C was considered in selecting the best CT lines, and many CT selections were rogued out because of difficulty in obtaining fruit set in the greenhouse.

Seed for initial screening of cold tolerance were obtained from varied sources; therefore, the environmental component contributing to variability in cold germinability may have been large. However, among selected CG lines, S₁ progeny exhibited a similar degree of cold germinability as the parental lines, indicating a genetic base for cold germinability (Table 1). Cultigens initially scored as NCG remained NCG in subsequent generations.

Cold germinability itself is not necessarily correlated with cold tolerance of the young plant (Scott and Jones, 1986). Although our

screenings for cold germinability in muskmelon were done in petri dishes, they were based on several indices and also on root development. Using this approach, our selected CG genotypes also exhibited better low-temperature germination and early seedling growth in a soilless medium than NCG genotypes (Hutton, 1988), suggesting that our screening method is a reliable method for identifying cold-germinable germplasm.

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Table 1. Germination performance of muskmelon cultigens from initial screening and S₁ seed incubated at 15C.

Cultigen	Germination index*		
	EI	HI	CI
Persian 202	240	264	286
S ₁	250	276	294
PI126156	240	250	275
S ₁	245	276	330
PI126101	245	336	336
S ₁	251	283	336
PI126082	240	250	285
S ₁	245	274	309
MN Midget	249	290	336
S ₁	262	309	336

*Indices are mean hours to radicle emergence (EI), hypocotyl elongation >1 mm (HI), and cotyledon expansion beyond seed coat (CI). Mean values = two replications of 10 seed each for initial screening and three replications of 15 seed each for S₁ progeny.

Fig. 1. Histograms of emergence index (EI), hypocotyl index (HI), and cotyledon index (CI) for 309 muskmelon cultigens incubated at 15C. Indices shown on abscissa are mean hours to stage of germination, and represent midpoints for classes of 10 h each. NR = no response.

Received for publication 13 Sept. 1990. Scientific contribution no. 1692 from the New Hampshire Agricultural Experiment Station. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked advertisement solely to indicate this fact.

¹Current address: Petoseed Co., Inc., Bridgeton, NJ 08302-8723.