Priming and Seed Orientation Affect Seedcoat Adherence and Seedling Development of Muskmelon Transplants

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Abstract. The effects of seed priming and seed orientation on seedcoat adherence and seedling development of containerized muskmelon transplants were investigated. Seeds of muskmelon 'Top Net SR' were primed for 6 days in darkness at 25 °C in an aerated solution of KNO₃ (0.35 M). Primed and nonprimed seeds were individually planted in Styrofoam trays in the greenhouse. Seeds were carefully oriented with the radicle down, up, or in the horizontal position, and covered with 0.5 cm of the growing mix. Seed priming and seed orientation affected both seedcoat adherence and seedling development, and interaction between priming and orientation was significant for seedcoat adherence. Our data indicate that seed priming can minimize seedcoat adherence during emergence of muskmelon seeds.

In recent years, several changes have occurred in the vegetable industry, including the production of transplants in greenhouses. In muskmelon (*Cucumis melo* L.), transplants have been used to shorten the time from planting to harvest. Generally, the time required for production of marketable muskmelon transplants has been from 4 to 5 weeks (Vavrina, 1994).

Low seed quality and inadequate conditions for seed emergence can be problems in transplant production. Also, adherence of the seedcoat to the emerged cotyledons occurs in some cucurbits, e.g., seedless watermelon [*Citrullus lanatus* var. *lanatus* (Thunberg) Matsumura and Nakai] (Maynard, 1989). Higher seedcoat adherence in watermelon was observed when seeds were positioned with radicle down or horizontal (Maynard, 1989). During seedling development of cucurbits, the hypocotyl elongates and the cotyledons are pulled free of the seedcoat, which often adheres to a peglike appendage at the base of the hypocotyl (Association of Official Seed Analysts, 1992). If the radicle and the appendage are not aligned properly, the seedcoat will adhere to the cotyledons during emergence (Cantliffe, 1984). This can slow down the germination process and cause deformed seedlings. In muskmelon, adherence of the seedcoat can occur when transplant trays are irrigated by a subirrigation (ebb-and-flow) system. In order to alleviate this problem in watermelon, Maynard (1989) recommended seed orientation with the radicle end up during sowing. Effects of seed orientation on emergence have

been reported in other cucurbits (Cantliffe, 1984; Gomaa, 1980) but not in muskmelon.

Seed priming accelerates germination and improves seedling uniformity in many species, especially under unfavorable conditions. Seeds are imbibed in an osmotic solution that allows pregerminative metabolism to proceed, but prevents radicle protrusion through the seedcoat (Heydecker et al., 1975; Parera and Cantliffe, 1994). The objective of this study was to verify the effects of seed orientation and seed priming on seedcoat adherence, seed emergence, and seedling development in muskmelon under greenhouse conditions.

Materials and Methods

Seeds of muskmelon, 'Top Net SR' (Harris Moran Seed Co., Modesto, Calif.), were primed for 6 d in darkness at 25 °C in KNO₃ (0.35 M) aerated solution (10 mL of solution per gram of seed). The air was prehydrated by bubbling it through water to minimize evaporation of soaking solution. The solution was changed

every 2 d. After this period, seeds were rinsed in running tap water (2 min) and redried at laboratory conditions [25 ± 2 °C; 50% relative humidity (RH)] for 4 d. Primed and nonprimed seeds were individually planted in Styrofoam trays (cell volume 22 cm³, corresponding to 200 cells/tray), containing a commercial peat growing mix (Metro-Mix 350; Scotts-Sierra Horticultural Products Co., Marysville, Ohio). Seeds were carefully oriented with the radicle down, up, or in the horizontal position, and covered with 0.5 cm of the growing mix. Four replications of 30 seeds from each treatment were used. The trays were placed in greenhouse conditions (20 to 32 °C; 65% to 85% RH) and watered by hand as needed. Seed emergence and seedcoat adherence were counted at 7 and 14 d after sowing. Leaf area was measured at 14 d, using a LI-3100 Area Meter (LI-COR, Lincoln, Nebr.). For determining shoot dry mass, four replications of twenty 14-day-old seedlings were used. Analysis of variance and factorial analysis were performed using the Statistical Analysis System (SAS Institute, 1988).

Results and Discussion

Seeds emerged 5 d after sowing. Seed priming did not affect the percentage of seedling emergence under greenhouse conditions (Table 1), probably because temperatures during the experiment were optimal (e.g., from 20 to 32 °C). Seed priming has resulted in early emergence of muskmelon at low temperatures (Bradford et al., 1988; Dhillon, 1995; Nerson and Govers, 1986). Seedling emergence was not affected by seed orientation, which is in agreement with results obtained for cucumber (*Cucumis sativus* L.), squash (*Cucurbita pepo* L.), and watermelon (Cantliffe, 1984; Gomaa, 1980; Maynard, 1989).

Seed priming and seed orientation greatly affected seedcoat adherence, and interaction between seed priming and seed orientation was significant (Table 1). Seedcoat adherence was observed only in seedlings in which seeds were sown with radicle down, and priming reduced its severity (Table 1). Seedcoat

Table 1. Muskmelon emergence, seedcoat adherence, leaf area, and shoot dry mass as influenced by seed priming and orientation.

Priming	Orientation	Seedling emergence (%)	Seedcoat adherence (%)		Leaf area (cm ²) ²	Shoot dry mass (g) ²
			7 d	14 d		
Primed	Horizontal	83	0	0	147	0.54
	Radicle down	88	20	15	144	0.50
	Radicle up	88	0	0	180	0.65
Mean		86	7	5	157	0.56
Nonprimed	Horizontal	94	0	0	139	0.49
	Radicle down	90	72	52	143	0.49
	Radicle up	87	0	0	155	0.54
Mean		90	24	17	146	0.51
Mean	Horizontal	88	0	0	143	0.52
	Radicle down	89	46	33	143	0.50
	Radicle up	88	0	0	167	0.60
Significance						
Priming (P)		NS	**	**	NS	*
Orientation (O)		NS	**	**	**	**
P × O		NS	**	**	NS	NS

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²Values represent means of 20 seedlings.

NS, *, **Nonsignificant or significant at $P = 0.05$ or 0.01 , respectively.

adherence was minimized by priming, presumably by wetting and/or weakening the seedcoat.

Although seedcoat adherence was still observed on 14-day-old seedlings, its effect on seedling development was nonsignificant; leaf area and shoot dry mass were not significantly affected. Seed priming enhanced shoot dry mass but did not affect leaf area (Table 1). Early growth of muskmelon was promoted by seed priming (Passam et al., 1989), and Alvarado et al. (1987) reported greater plant dry mass and leaf area of seedlings from primed seeds of tomato (*Lycopersicon esculentum* Mill.). Seed orientation also affected seedling growth (Table 1). Because cucurbit cotyledons emerge hypocotyl end first, and the appendage holds the seedcoat, seed orientation influences the amount of rotation required for emergence (Gomaa, 1980). Thus, for those seeds positioned with radicle tip up, no additional time was required for the hypocotyl to rotate. This might contribute to rapid full expansion of cotyledons and early differentiation of true leaves.

Both genotype and irrigation system used

during transplant production may affect seedcoat adherence in cucurbits. In order to alleviate this problem, seed orientation during sowing has been recommended. However, this could increase time and labor costs. Our data indicate that, in addition to other advantages, seed priming can minimize seedcoat adherence during emergence of muskmelon seeds.

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