Abstract

Seed priming is a controlled hydration process, followed by dehydration, that allows pregerminative metabolic activity to proceed without germination. The objective of this research was to investigate the effects of priming on intrinsic characteristics of seed germination including temperature, water, and development, in order to understand how priming affects the germination of broccoli (*Brassica oleracea* var. *italica* Plenck) seeds. Priming of broccoli seeds consistently improved germination and emergence rate in the laboratory and field and was related to the accumulation of a specific level of hydropriming units expressed in MPa. Priming reduced the sensitivity of seed germination to temperature and increased the temperature range of germination but did not lower the minimum temperature for germination. Primed seeds leaked less electrolytes at supraoptimal temperatures (>35 °C) compared to nonprimed seeds. In the field, primed seeds produced a greater plant stand and yield under stressful emergence conditions. Under optimal conditions in the field for stand establishment, the advancement in emergence of primed seeds did not carry over to earlier, greater yields. Matric priming, using calcium silicate as the carrier in the ratio 1.0:0.8:1.8 (seed:carrier:water; by weight) for 7 d at 20 °C, was superior to osmotic priming using polyethylene glycol (PEG 8000) at 1.2 MPa in nearly all variables examined. This may be attributed to reduced respiration during priming of seeds in PEG or nutrient uptake by seeds in calcium silicate.

The testa was observed to be a barrier to broccoli seed germination. Priming-induced changes to the physical characteristics of broccoli seeds included increased volume (32%) and an irreversibly expanded, and weakened testa with some minute cracking near the area where the radicle emerges. Primed seeds germinated faster, in part by maintaining a lower hydrotime constant, and thus exhibited a greater progression towards germination per unit water potential at a constant temperature compared with nonprimed seeds. It was hypothesized that, since the testa threshold was reduced after priming by expansion and formation of free spaces, the reversibly expanded embryo of primed seeds does not become immediately appressed to the testa upon rehydration. Thus the yield threshold component controlling the rate of germination of primed seeds is lower by the amount of the testa threshold. The priming effect is more than just reducing the yield threshold as indicated by a significant invigoration of seeds with split testae. Despite the increased volume as a result of the formation of free spaces, primed broccoli seeds did not imbibe more water or have a greater turgor at full hydration. Priming did not lower the minimum water potential allowing germination, and primed seeds did not plateau in water uptake but, instead, moved immediately from imbibition to expansive growth. Priming improved the germination rate of broccoli seeds at all stages of maturity with the most significant effects at stages before attainment of maximum dry weight. Dry storage of broccoli seeds at harvestable maturity (>56 days after pollination) did not improve germination, indicating a lack of postharvest dormancy.