Genotypic Variation and Pretreatment Effects on Triploid Watermelon Seed Germination

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Introduction

Triploid (seedless) watermelon seeds suffer low and inconsistent germination due to thick seed coats, poor embryo quality, low starch reserves, and high sensitivity to environmental conditions, such as moisture (Grange et al., 2000, 2001, 2003; Wang et al., 2001, 2011). These constraints increase production costs and complicate breeding and transplant production (Athearn et al., 2000). Seed coat scarification, exogenous plant growth regulating hormone pretreatments, and hydrogen peroxide (H_2O_2) imbibition have each been shown to improve germination (Duval et al., 2000; Schneider et al., 2012; Turner et al., 2024). However, their combined effects on distinct species, ploidy, and cultivars remain unclear.

This study evaluated physical and chemical scarification, as well as gibberellic acid (GA_3) pretreatments, in combination with H_2O_2 imbibition to improve the germination of five commercial triploid watermelon cultivars. These findings should refine protocols for future physiological and genetic studies aimed at characterizing the mechanisms underlying successful triploid germination.

Methods

The cultivars Fascination, Extazy, Liberty, Orange Crisp, and Tri-X Palomar were treated in a completely randomized design using three replications of five seeds per petri dish. The seeds were sterilized in 5% NaOCl for 15 minutes, rinsed thoroughly with dH_2O, then dried with a paper towel prior to pretreatment. Assays investigated seed coat alterations with physical and chemical scarification. Physically scarified seeds were nicked with nail trimmers on the end opposite the radicle and removed approximately 3x1 mm of the seedcoat. Chemically scarified seeds were submerged in 10N H_2SO_4 for 20 minutes with occasional stirring.

Following this acid bath, seeds were neutralized in 1% NaOCl for 1 minute prior to being thoroughly rinsed with dH_2O and patted dry with a paper towel. Another assay compared exogenous hormone pretreatment concentrations using GA_3 from 50-400 ppm.

Hormone treated seeds were soaked in GA_3 for 4 hours, rinsed with dH_2O, and then dried with a paper towel. After all pretreatments, the seeds were plated onto 9mm petri dishes lined with filter paper, then imbibed with either 8mL of dH_2O or 1% H_2O_2. The dishes were incubated in the darkness of a growth chamber for two days before being exposed to the light. Final germination was measured after 12 days of incubation.

Results

In every experiment there were significant differences between cultivars ($p < 0.05$). Scarification assays had significant differences between treatments that were imbibed with H_2O_2, with mean germination ranging 50% when treated with H_2SO_4 to 78-81% for unscarified and nicked seeds, respectively. However, treatments imbibed in dH_2O averaged germination between 4-16% and were not significantly different. GA_3 pretreated seeds imbibed with H_2O_2 had

increased mean germination between 77-84%, and a significant concentration interaction effect with the genotype. However, the same exogenous hormone applications in dH_2O showed lower germination between 15-27% with no significant interaction.

Conclusions

These results support previous work demonstrating the sensitivity, numerous constraints, and strategies for improving triploid watermelon seed germination (Phat et al., 2015). Our results demonstrate that a H_2O_2 not only enhances germination but also facilitates pretreatment responsiveness that is cultivar-dependent and seems cultivar-dependent. Further research is utilizing these findings to refine protocols for the genetic characterization of essential metabolic mechanisms during triploid germination.

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