Acceleration of Sweet Corn Germination at Low Temperatures with Terra-Sorb or Water Presoaks

Cathy Sabota,1 Saula Bey1 and Jo Ann Biedermann2
Department of Plant and Soil Science, Alabama A&M University, Normal, AL 35762

Abstract. Early season sweet corn has a potentially greater market value than peak-season sweet corn. However, most sweet corn cultivars, especially the "super sweet", do not germinate well at temperatures below 10°C. To determine if pregermination treatments could be an effective means to accelerate corn germination in cool soils, seeds were treated and then incubated at 4.4°, 7.2°, and 10.0°C. Treatment included seed presoaked in an aqueous preparation of Terra-Sorb GB (TS) or water for 24, 48, 72, and 96 hr before incubation. The cooler the incubator temperature, the greater the differences among water, TS, and control treatments. Pretreatments with TS or water were an effective means to accelerate corn germination in cool soils, whether or not the seed is subsequently fluid-drilled or planted with a traditional dry seeder.

In this study, we examined the rate and extent of germination of corn at three temperatures (4.4°, 7.2°, and 10.0°C) using either water or TS presoak treatments for various lengths of time to assess the potential of this technique for early season sowing of pregerminated corn seed under field conditions. Temperature effect could not be evaluated simultaneously due to a limited number of incubators; therefore, each temperature experiment was conducted separately but in a similar manner. This precludes statistical comparison for the same treatments among temperatures. 'Florida Stayseed', a shrunk-seed, supersweet cultivar, was pregerminated at 22°C for 0 (control), 24, 48, 72, or 96 hr in either water or 26.7 g liter⁻¹ TS and then incubated at 4.4°C up to 15 days, at 7.2°C for 16 days, or at 10°C for 13 days. 'Silver Queen', a standard sweet corn, was also incubated in the 10°C treatment at the same time as 'Florida Stayseed' using the same experimental regime, allowing comparison. All pregermination treatments were administered to 10 seeds/30 ml plastic beaker in 25 ml of water or TS. After pregermination and prior to incubation, seeds were re-watered with the pregermination medium and the percentage of those seeds whose radicle and/or coleoptile were visible and had broken the seedcoat were determined. Unrinsed TS- and water-treated seeds were placed on Whatman #3 filter paper in 9-cm plastic petri dishes moistened with 10 ml deionized water, and were remoistened as needed. Treatments, replicated four times, were completely randomized within the incubator. All controls were untreated seeds placed in covered petri dishes. They were watered and placed in the incubator at the same time as the other treatments. Radicle and coleoptile emergence were recorded at regular intervals, subjected to analysis of variance and a

Several preplanting seed treatments have been developed to improve germination and seed emergence at low temperatures, including osmoconditioning (4, 7), wetting and then drying (1, 5), and fluid drilling (3). Fluid drilling of pregerminated seeds suspended in

Received for publication 7 July 1986. Terra-Sorb GB was donated by Industrial Services International, Inc., Bradenton, Fla.; 'Florida Stayseed' was donated by Illinois Foundation Seeds, Champaign, Ill.; and 'Silver Queen' was donated by Rogers Brothers Seed Co., Idaho Falls, Idaho. Mention of the trade name in this publication does not imply endorsement of the product nor criticism of similar ones not mentioned. 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.

1Assistant Professor.
2Research Associate.
mean separation using Duncan’s multiple range test (8) on days 2 and 6 or 7. Data in Figs. 2, 4, and 7 were derived from the percent germination on the final day of incubation minus that on the initial day of incubation and were expressed as Δ radicle emergence or Δ coleoptile emergence. These data were subjected to regression analysis (8).

At 4.4°C, presoaking seeds of ‘Florida Stay sweet’ in water or TS significantly enhanced germination over the control incubated with no presoak period (Fig. 1). The longer water presoaks of 72 and 96 hr had a higher percentage germination at the start of the incubation period and very few more germinated over the 12-day period in incubation. This may have been due to anaerobic conditions in the longer-duration water presoak, reducing viability. Pregermination in TS significantly enhanced preincubation germination of the 48-, 72-, and 96-hr presoaks over water-presoaked seeds to the point that germination of all treatments exceeded 72.5% at the start of the incubation period (Fig. 1).

However, the 24-hr TS pregermination treatment had only 20% germination upon entry into incubation. The greatest difference between final and initial germination percentages (Δ radicle emergence) for TS presoaks occurred with the 24-hr duration as opposed to 48 hr for the water presoak (Fig. 2). The equations representing the Δ radicle emergence as a function of TS and water presoaks were highly significant and accounted for 68% and 86% of the variation, respectively. Even though the magnitude of the difference was greater with water (Fig. 2), the final germination of the two treatments was not significantly different at 70% for the 24-hr TS vs. 62.5% for the 48-hr water (Fig. 1).

At 7.2°C, radicle and coleoptile emergence trends were similar to those observed in the 4.4°C experiment. All water presoak treatments consistently had lower germination percentages than the very high initial germination percentages of all the TS presoak treatments (Fig. 3). Only in the 24-hr TS presoak was germination not too far advanced at incubation to see a substantial increase in germination over the 16-day time period (Figs. 3 and 4). The optimal presoak duration resulting in the highest Δ radicle emergence for both water and TS was 24 hr (Fig. 4). At 4.4°C, water presoak time was optimal at 48 hr (Fig. 2). The magnitude of the Δ radicle emergence was greater with 24-hr water presoak than 24-hr TS presoak, but this is a reflection of the higher initial germination percentage of the TS presoak (Fig. 3). The greatest change in coleoptile emergence (Δ coleoptile emergence) during incubation at 7.2°C occurred with the 72-hr TS presoak. There was no change in coleoptile emergence with any duration of water presoak (Fig. 4). The equations representing the Δ radicle emergence as a function of TS and water presoaks were both highly significant and accounted for 53% and 83% of the variation, respectively. However, the equation for the Δ coleoptile emergence as a function of TS presoak accounted for 38% and was
significant at only the 5% level.

At the warmer temperature of 10°C, water presoaks were almost as valuable as TS presoaks in relation to final germination (Figs. 5 and 6). For both 'Florida Staysweet' and 'Silver Queen', all TS presoaks had a higher preincubation percentage of germination than did the corresponding water presoak. This difference remained significant for up to 2 days into incubation (Figs. 5 and 6). Only the 24-hr TS presoak treatment was not too advanced in both cultivars to see a substantial increase in germination over the 13-day incubation period (Fig. 7). The Δ radicle emergence for control treatments of 'Florida Staysweet' and 'Silver Queen' reflect the differential sensitivity to germination at 10°C inherent in each cultivar. The Δ radicle emergence during incubation was significantly greater for water-presoaked than for TS-presoaked seed. The optimal TS and water presoaks for Δ radicle emergence of 'Silver Queen' seeds were 24 hr earlier than the optimal treatments for 'Florida Staysweet', a shrunken-seed variety. Also, the optimal levels of TS presoak for both cultivars was 24 hr earlier than the corresponding water presoak. The equations representing the Δ radicle emergence as a function of TS and water presoaks for both cultivars were all highly significant and accounted for 60–87% of the variation. There was greater Δ coleoptile emergence for TS-presoaked than for water-presoaked seed, a trend already seen at the lower temperatures of 4.4°C and 7.2°C. The equation for Δ coleoptile emergence as a function of TS presoak was highly significant and accounted for 64%, whereas the water presoak accounted for only 44% and was significant at only the 5% level.

A comparison of 24-hr TS- or water-presoak treatments at each temperature illustrates that the TS treatments resulted in the highest germination percentages (Figs. 1, 3, 5, and 6). Because the preincubation germination of TS presoak treatments was much higher than the water treatments at all three temperatures, the actual magnitudes of Δ radicle emergence during incubation were lower...
Fig. 7. Regression model for the effect of presoak treatments on Δ radicle and Δ coleoptile emergence of ‘Florida Staysweet’ and ‘Silver Queen’ during incubation at 10.0°C.

For TS than for water. Just the opposite was true of the coleoptile emergence during incubation. Seeds presoaked in TS were more advanced upon incubation and continued to develop at a significantly greater rate than the water-presoaked seeds. The 24-hr TS presoak time resulted in the greatest increase in radicle emergence, but, it was the 72-hr TS presoak treatments that resulted in the greatest change in coleoptile emergence during incubation. However, if coleoptile and radicle emergence during incubation are considered simultaneously, the 24-hr TS presoak treatment provided the best overall combination at all temperatures. Although seeds presoaked in TS for >24 hr resulted in the same or greater change in coleoptile emergence, the sizes of the emerged radicles at the onset of incubation in the longer presoak treatments were large enough to be a deterrent to mechanical planting. The 24- and 48-hr water presoaks resulted in a significant increase in radicle emergence during incubation over controls at all three temperatures; however, there was little or no corresponding change in coleoptile emergence.

Caution is advised before extrapolation of these findings conducted on filter paper to similar conditions in the field. Seed performance of pepper differed in filter paper studies vs. those conducted in Jiffy Mix (6). This initial work with TS and water pregermination to enhance and accelerate germination cannot be assumed to increase emergence under field conditions until the technique has been verified by actual field trials.

Literature Cited