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Soybean Seed Coat Damage Test

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The soybean seed coat damage test quickly identifies three different levels of physically damaged seed – undamaged, slight damage, and damaged. This test has many applications for the soybean industry, ranging from seed production to grain handling and food production. This test has been called the "soak test" or "hypochlorite soak test" and provides a fast and accurate method to determine soybean seed coat damage.

HYPOCHLORITE VERSUS COFFEE

VanUtrecht et al. (2000) evaluated the sodium hypochlorite soak test for use in grain handling and trade. The US soybean grain grading criteria accounts for soybean splits and fines, but not for the accelerated deterioration and sensitivity to further damage resulting from mechanical damage to whole soybean grains. By subjecting the soybeans to several different levels of controlled mechanical damage, the authors were able to evaluate the ability of the test to detect mechanical damage. Through this study, the authors concluded that though not as sensitive as the indoxyl acetate test, the sodium hypochlorite test provided a more consistent evaluation of mechanical damage. The sodium hypochlorite test also required simpler substrates and equipment, unlike the indoxyl acetate test which requires a fume hood.

Requiring only about 15 minutes, household bleach (sodium hypochlorite), water, and dishes for soaking, the test can be performed in the field, conditioning plant, or seed testing laboratory. Four replicates of 100 seeds are soaked in a 1:5 dilution of bleach for 10 minutes. Following the soak period, wrinkled seeds are considered to have slight damage and swollen seeds (typically double or triple their original size) are considered damaged (ISU Seed Laboratory Staff, 1992). 10% or more damage indicates a seed quality concern (Krzyzanowski et al., 2004). Segalin et al. (2013) found that larger seeds were more prone to mechanical damage as detected by the sodium hypochlorite test. Low moisture (7%) seeds are more susceptible to mechanical damage than high moisture (21%) seeds (VanUtrecht et al., 2000). Additionally, low seed coat lignin content can make seeds more susceptible to mechanical damage (Carvalho & Novembre, 2013). SoDak Labs uses hot coffee at 60°C (140 °F) as the soak solution in place of a hypochlorite solution. Coffee works well and the brown color of the solution is a nice contrast to the soybean, making it easier to find damaged seed. This method also can be completed in 3–5 minutes.

Rodda et al. (1973) describes the importance of using undamaged soybeans in human food production to ensure the palatability of the final product. In their study, Rodda et al. tested the ability of the hypochlorite soak test to remove damaged beans through a screening procedure following the soak period and found it to be effective. The removal of the damaged beans through this soak and screening process improved the germination percentages from a range of 90–94% to 94–98%.

FIGURE 1. Soybean seeds soaking in 60°C (140 °F) coffee to detect physical or mechanical damage to the seed coat.

FIGURE 2. Soybean seeds were immersed into hot coffee for three minutes. The swollen oblong seeds on left are damaged. The wrinkle seeds (middle) and firm seeds (right) are considered undamaged.

SEED VIABILITY AND VIGOR INDICATION

Santorum et al. (2013) investigated the relationship between tetrazolium, electrical conductivity, and hypochlorite soak tests. In this study, they found that the hypochlorite soak test and the tetrazolium vigor test gave differing results on whether to reject a seed lot. As the sodium hypochlorite test examines the external physical properties of the seed and the tetrazolium test examines the seed biochemical and internal physical properties, this is to be expected. While Santorum et al. (2013) did not identify statistically significant differences between lots in the hypochlorite soak test, it is worth noting that the lot with the highest percentage of damaged seed scored the lowest on the field emergence test. Carvalho & Novembre (2013) identified the ability of the tetrazolium test to detect mechanical damage that may have a more latent effect than what the sodium hypochlorite soak test can. However, the authors also noted that the sodium hypochlorite soak test offers an extremely quick (15 minutes) diagnosis of mechanical damage to the seed lot.

SoDak Labs grouped seed coat damage results into five quality ranges for 3,134 soybean samples to determine the impact on seed viability and vigor. As seed coat damage increased in the samples a decrease was also observed for both sand germination and accelerated aging.

TABLE 1. Five seed coat damage quality ranges of soybean seed and corresponding quality responses for sand germination and accelerated aging tests. Data in Table 1. represents the averages of 3,134 samples tested over the last 6 years.

Seed Coat Damage Range	# of Tests per Quality Range	Average Seed Coat Damage	Sand Germination Strong Normal Seedlings %	Accelerated Aging Normal Seedlings
---------%--------		--------%-------	----------%----------	----------%----------
0-5	546	4	94	84
6-10	916	8	90	78
11-15	712	13	87	72
16-20	473	18	82	66
20+	487	27	78	59

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