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Saturated Cold Test Evolution V.062021

HISTORY

Goodsell, Huey and Royce (1955) published a water wicking system to establish a saturated soil condition which is still the basis of the "saturated cold test" used today. The saturated cold test soil moisture level is roughly double that of the same soil type, used in the tray cold test as reported by TeKrony and Woltz (1997). TeKrony and Woltz (1997) reported this high moisture level of dried, ground, screened soil results in increased oxygen stress compared to the tray cold test. TeKrony and Woltz (1997) also reported anaerobic conditions can result when the embryo is pressed into the soil surface.

CURRENT USAGE

In 2002, the "Goodsell" (1955) and "Template" (1994) methods for conducting the saturated cold test were added to the AOSA "Seed Vigor Testing Handbook" making them available to seed technologists (Figure 1.). A 2008 survey found 18% of seed testing laboratories reported using the saturated cold test for testing seed corn. The 2009 revision of the AOSA "Seed Vigor Testing Handbook" states that three stress factors are imposed: 1) imbibitional chilling injury, 2) attack by soil-borne pathogens and 3) limited oxygen availability. The 2009 revision also states to classify seedlings into three categories: 1) Normal, 2) Abnormal and 3) Dead in accordance with the AOSA "Seedling Evaluation Handbook."

SODAK LABS, INC (SDL) SATURATED COLD TEST METHOD

SoDak Labs utilizes two of the three saturated cold stress factors mentioned in the AOSA Vigor Handbook. Imbibitional chilling and limited oxygen availability are used, attack by soil-borne pathogens is not used in the SoDak Labs saturated cold test. In 2016, SDL added *a fourth seedling classification group (Slow Normal)* (Figure 2.) to describe slow growing normal seedlings. SDL made this decision when we noted low tray cold emergence (75–79%) while the saturated cold "total" normal percentage (normal + UV) was 6–7% higher on 2–3-year-old inventory seed. Saturated cold results from SoDak now contain four categories. Seed corn company staff have asked questions about this classification, so we want to clarify, that the slow normal seedling category are still considered normal. However, seedlings are 35–70 GDDs (Table 1) slower than strong normals and are not included in the strong normal seedling percentage. SDL believes this separation of normal seedlings (strong vs slow) allows individuals to better evaluate overall seed quality. In certain hybrids/ circumstances, it may be appropriate to add back the slow normal % to the normal %. This "total" normal seedling value is what SDL believes most seed laboratories are currently reporting for the saturated cold test.

To investigate the impact of this change to routine saturated cold testing, we created a database from 2017–2021 testing representing 13,904 saturated cold tests (Table 2.).

FIGURE 1. Radical and plumule tissue emerging on 8th day (40 Growing Degree Days, GDD) of a "Template Method" Saturated cold test.

FIGURE 2. Dead, abnormal, slow and strong normal seedlings from saturated cold test (100 GDD).

EVOLUTION OF THE SATURATED COLD TEST, *CONT.*

We grouped and averaged the data across five quality ranges. The impact of classifying the slow normals (SN) resulted in a range of 3–25% (Table 2.) of slow seedlings across the five quality groups. Dead seeds and SN seedling percentages track each other very closely varying only 1–4% (Table 2.) across all 5 quality ranges. As the seed lot (seed population) ages, one would expect an increased percentage of normal seedling showing slow growth. An aging seed population (seed lot) would be expected to contain, strong normal seedlings, slow normal seedlings, physiological abnormal seedlings and dead seeds (Figure 2.). At SoDak, we believe using the "SN or slow normal category" helps individuals rank seed quality better. We do see cases where it is appropriate to combine strong and slow normal into total normal in the saturated cold test. Data presented in Table 3 represents 681 seed corn lots submitted by the end user/farmer for testing. We separate these into 5 quality ranges based on the saturated cold test results. Saturated cold, NPK cold (tray cold with starter fertilizer added) and bulk electrical conductivity (EC) related well. Pericarp damage levels (Severe & Medium) showed some variable relationship to the saturated cold test results.

TABLE 1. Comparison of Strong and Slow Normals (SN), from 30 test samples, and GDDs required for SN to reach 2.54cm or more in height.

GROUP	GDD1	Strong Normal	Height (cm)	Slow Normal	Height (cm)	GDD2*	Height (cm)	GDD3**	Height (cm)
1	101	85	3.8	13	1.6	136	2.6	172	4.8
2	101	76	3.5	21	1.4	135	2.9	170	5.5
3	100	58	3.0	30	1.8	135	2.8	172	4.0
4	100	28	2.8	59	1.5	134	2.3	171	4.4

*Slow Normals (SN) were extended to 135 (GDD2) and 170 (GDD3) and reevaluated for growth.

**At GDD3 not all samples had data since some exceed 2.54cm height at GDD2 and were not extended to GDD3.

TABLE 2. 2017 to 06/2021 Saturated Cold Response from 13,904 tests.

Normal Seedling Quality Range (%)	# Tests per Quality Range	Percent of Total Samples	Strong Normal Seedlings	UV or Slow Normal Seedlings	Abnormal Seedlings	Dead Seeds
90–100	4350	31	93	3	1	2
80–89	4048	29	85	8	2	5
70–79	2237	16	75	13	3	9
60–69	1387	10	65	17	3	15
<60	1882	14	42	25	4	29

TABLE 3. Quality responses of 681 farmer submitted seed corn lots (Jan.–May 2021) tested across three vigor tests and one mechanical damage test.

Saturated Cold Range	# of Tests per Quality Range	Percent of total samples	Saturated Cold				NPK Cold Tray Test		Pericarp Damage			Bulk EC
			%									
			Strong Normal	Slow Normal	Abnormal Seeds	Dead seeds	Strong Normal	Slow Normal	Severe & Medium	Light	None	µS cm^{-1} g^{-1} seed
90–100	266	39	93	4	2	2	95	0	7	12	81	14
80–89	220	32	85	8	2	4	93	1	10	15	75	17
70–79	111	16	75	14	3	9	91	1	8	16	77	18
60–69	53	8	65	22	3	11	91	0	7	15	77	19
<60	31	5	48	25	3	24	82	1	10	12	78	21

LITERATURE CITED:

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