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Saturated Cold Test Evolution

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.

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 (UV or Uniformity Varies) and strong normal seedlings from saturated cold test (100 GDD).

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 (UV or uniformity varies)* (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 (Table 1. Lots B & D). Saturated cold results from SDL, as shown in Table 1, now contain four categories. Seed corn company staff have asked questions about this classification, so we want to clarify, that UV/slow seedling category are still considered normal seedlings. However, UV seedlings are slower growing and not included in the normal 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 UV/slow % to the normal %. This "total" normal seedling value is what SDL believes most seed laboratories are currently reporting for the saturated cold test.

EVOLUTION OF THE SATURATED COLD TEST, *CONT.*

To investigate the impact of this change to routine saturated cold testing, we created a database from 2017–2018 testing representing 2,225 saturated cold tests (Table 2.). We grouped and averaged the data across five quality ranges. The impact of classifying the UV seedlings (slow normal) resulted in a range of 3–25% of UV/slow seedlings across the five quality groups. Dead and UV seedling percentages track each other very closely varying only 1–3% 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 "UV 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.

LOT	STANDARD GERM (%)				TRAY COLD (%)			SAT COLD (%)			
	Normal	Abnormal	Dead	Remarks	Normal	UV	Remarks	Normal	Abnormal	Dead	UV
A	100	0	0	LPB	99	0		94	1	2	3
B	96	2	2	SL	79	5		70	2	13	15
C	98	1	1	IR, LPB, SL	90	2		58	0	12	30
D	95	3	2	SS	77	6		72	2	14	12
E	99	1	0	IR, SS	98	1	SL	89	1	1	9

TABLE 1. Comparison of Standard Germination, Tray Cold, and Saturated Cold responses on 5 seed corn lots. (LPB = leaf protruding at coleoptile base, IR = insufficient roots, SL = shredded leaves and SS = stunted shoot)

SATURATED COLD	AVERAGE (%)				
Normal Seedling Quality Range (%)	# Tests per Quality Range	Strong Normal Seedlings	Abnormal Seedlings	Dead Seeds	UV or Slow Normal Seedlings
90–100	434	93	2	2	3
80–89	582	85	3	5	8
70–79	478	75	3	10	12
60–69	341	65	4	15	17
<60	390	45	4	26	25

TABLE 2. 2017–2018 Saturated Cold response from 2,225 tests.

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