SOLVITA® CO₂ test kit to detect grain fungal spoilage
Why measure grain fungal growth rate?

The rate at which fungi grow, when grain is incubated at moistures and temperatures conducive to fungal growth, is a good indicator of grain’s susceptibility to fungal invasion if it encounters “stressful” ambient conditions during harvest, transport and storage. (D. J. P. Moog, R. L. Stroshine, and L. M. Seitz, 2006 Cereal Chem. 85(1):19–26)

“Measurement of CO$_2$ respiration from grain samples is an effective means to quantify dry matter loss and quality deterioration caused by fungal invasion.” (Saul and Steel, 1966, Seitz et al., 1981; Marks, 1993; Barn et al, 2002).
Fungi (particularly Aspergillus and Fusarium genera) are aggressive and opportunistic in nature and can attack grain under biological, environmental, physical (drying, harvesting or handling) and storage stress conditions.
CO₂ correlates with all attributes or biological processes linked to fungal growth

$r^2$ regression analysis of CO₂ comparisons with:

- **Dry Matter Loss (DML)**: “Measurement of CO₂ respiration from grain is an effective means to quantify DML.” (Saul and Steel, 1966, Seitz et al., 1981; Marks, 1993; Barn et al, 2002).
- **Ergosterol**: $r^2 = 0.75$ - June 2010 issue of AACC  Cereal Chemistry
- **Electrolyte Leakage**: $r^2 = 0.62$ - Marks and Stroshine, 1998.
- **Seed Germination**: $r^2 = 0.72$ - Moog et al, 2008.
- **Free Fatty Acid**: $r^2 = 0.88$ - Ileleji et al, 2003
- **Rate of Fungal development**: $(r^2=0.83)$ with number of propagules of *Aspergillus* and *Penicillium* spp. and percent kernels infected with these fungi - Fernandez et al., 1985.
What moisture and temperature indicators do not tell you

...but what CO2 grain respiration does:

- Grain fungal activity and rate of growth
- Grain Dry Matter Loss
- BCFM or SHBN
- Grain cuticle or cell membrane damage
- Seed viability
- FFA and racidity
- POTENTIAL FOR FURTHER SPOILAGE
"When moisture content of the grain mass is sufficiently high, there is a succession in fungal development." (Stroshine et al., 1986; Sauer et al., 1992)
Rate of CO₂ respiration is grain’s way of expressing its health history

Fungal activity is induced under optimal moisture re-wetting conditions and rate of CO₂ generation is proportional with rate of fungal growth, reflective of the grain damage index.

Damage Index (Susceptability to Fungal Contamination)*
(Combination or degree of Stress Factors – a,b,c,d)

- severe
- high
- moderate
- low
- normal

Stress Factors (slide 3)*:

- a. 🌧️
- b. 🌞
- c. 🌾
- d. 🍴

* Wheat kernels infected at different stages while subjected to varying degrees of biological, environmental, physical and storage conditions (a,b,c,d - respectively).
Solvita® vs. storage bin CO₂ sensors

**Solvita® CO₂ grain test kit**

- Measures CO₂ directly from grain using gel-indicator.
- 100 g sample in sealed 8oz polystyrene jar simulates bin headspace, without CO₂ leakage or distortion.
- 100% CO₂ generation from grain source gives exact grain spoilage condition.
- Two “rewetting” Purdue-Stroshine protocols (72 and 24 hours) and 4 hour Woods End™ Lab in situ method.
- Requires representative composite sample from truck, unit-train or barge, or from storage bin “coring process”.
- Data-management for harvest to bin traceability gives accurate grain condition history.

**Storage Bin CO₂ sensors**

- Measure CO₂ from top vents and base aeration fan outlets (via radio or IR wavelength transmission).
- Sensitive to temperature, moisture and dust.
- Bin leakage, headspace venting affect CO₂ levels.
- Aeration flushes the CO₂ from the bin.
- Climatic conditions can effect CO₂ levels.
- Does not differentiate grain fungal CO₂ respiration from insect metabolic activity.
- Cannot interpret past storage history due to variations in bin design and management.
- High set-up cost for remote monitoring systems.
- Stability and reliability are issues of concern.
Thank You

For more information, please visit our websites:

http://www.woodsend.org
http://www.solvita.com

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