SOLVITA® CO_2 test kit to detect grain fungal spoilage

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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).

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Stress conditions that predispose grain to fungal infection

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.

Biological Factors:

- Susceptible Crop
- Hybrid and germ size
- Compatible Pytotoxigenic molds

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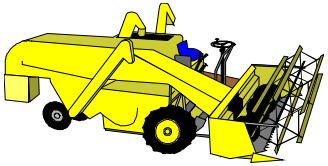
Environmental Factors:

- Temperature
- Moisture
- Insect/ Bird damage
- Fungus



Physical Factors:

- Crop maturity
- Substrate moisture
- Drying and handling damage
- Mechanical damage

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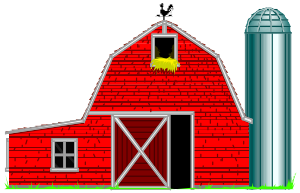

Storage Factors:

- Temperature
- Moisture
- BKFM
- Insects
- Saprophytic molds
- Inter -grain ERH

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CO_2 correlates with all attributes or biological processes linked to fungal growth

r^2 regression analysis of CO_2 comparisons with:

- **Moisture**: r^2= 0.83 - Fernandez et al, 1985. r^2 = 0.93 Carl J. Bern et al, 2004.
- **Dry Matter Loss (DML)**: "Measurement of CO_2 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.

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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**

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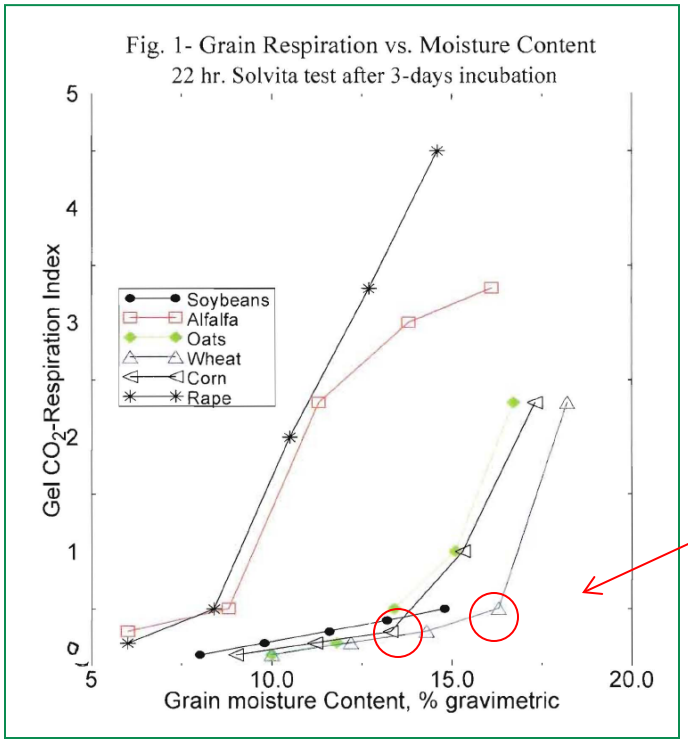
CO_2 respiration vs. critical MC thresholds



MC inflection points (in corn and wheat) for fungal growth and accelerated CO_2 respiration.

"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)

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Rate of CO_2 respiration is grain's way of expressing its health history

Fungal activity is induced under optimal moisture re-wetting conditions and rate of CO_2 generation is proportional with rate of fungal growth, reflective of the grain damage index.

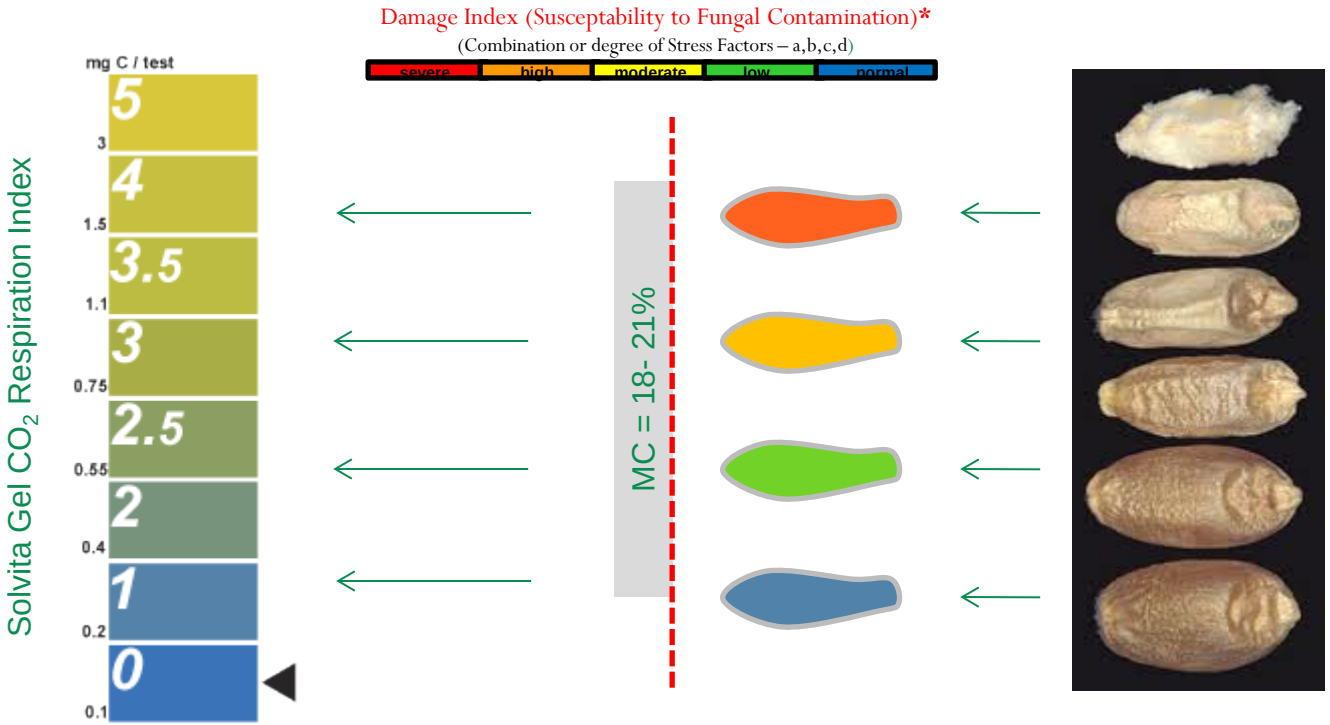
Stress Factors (slide 3)*:

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).

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Solvita® vs. storage bin CO_2 sensors

Solvita® CO_2 grain test kit

- Measures CO_2 directly from grain using gel-indicator.
- 100 g sample in sealed 8oz polystyrene jar simulates bin headspace, without CO_2 leakage or distortion.
- 100% CO_2 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-manaagement for harvest to bin traceability gives accurate grain condition history.

Storage Bin CO_2 sensors

- Measure CO_2 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 CO_2 levels.
- Aeration flushes the CO_2 from the bin.
- Climatic conditions can effect CO_2 levels.
- Does not differentiate grain fungal CO_2 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.

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Thank You

For more information, please visit our websites:

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