Australian Grain Industry – Code of Practice Technical Guideline Document

No. 3
SPROUTED GRAIN ASSESSMENT

Compiled on behalf of the Australian Grain Industry by:
Grain Trade Australia

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Technical Guideline Document

No. 3 Sprouted Grain Assessment

Version Control

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March 2013	1.0	Original document development
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2. Application

For the assessment of sprouted grain in cereal commodities.

Industry should note the following:

- The assessment of sprouted grain and associated quality parameters in barley is currently under review and this Technical Guideline Document (TGD) may be updated following the outcome of that review;
- A separate quality parameter called Shot may exist in some Trading Standards, generally being described as the early stages of grain sprouting. Different tolerances may exist for Shot and Sprouted. In many instances while definitions and tolerances may differ, reference to Sprouted grains in this TGD may equally apply to Shot grains;
- This TGD mainly focuses on the use of the Falling Number (FN) instrument to assess Sprouted grain, as this is the most common instrument used by industry; and
- This TGD does not include a detailed description of the Rapid Visco Analyser (RVA), however some information on the RVA is included.

3. Discussion on Sprouted Grain Assessment

3.1 What is Visually Sprouted Grain

Visually sprouted grains are those grains in which the covering of the germ is split. It includes any further advanced stage of growth of the germ. Note that for different commodities:

- The level and extent of the split of the germ may vary before being classified as Sprouted.
- Visual Recognition Standards Guides (VRSG) should be reviewed to determine the visual appearance of Sprouted grains for each commodity.

3.2 Standards to Apply

In Australia, standards for Shot and/or Sprouted do differ by commodity:

- For commodities such as wheat and barley there is a nil tolerance for visually sprouted grain in most of the milling and malt grades, unless a reference method such as FN or RVA is conducted.
- Either a tolerance or an unlimited tolerance may apply for Sprouted grain in feed grades depending on the commodity.

- For those commodities where a reference method can be used to assess quality, that result over-rides the visual assessment of visually sprouted grain. The implications for industry are that the reference methods are more capable in the detection of damaged grains, than the visual methods.

3.3 When to assess Sprouted Grain

a) Visual - when applying industry standards and a tolerance exists for the level of visually sprouted grain, each sample/load must be assessed for this quality parameter.

b) Reference method - if an industry standard contains limits for one or more reference methods related to sprouted grain i.e., FN or RVA, industry may or may not choose to apply that reference method. At any time, industry may choose to assess a sample/load using a reference method. Typically a reference method will be used:

- When sprouted grain is visually detected in the sample/load; and/or
- It is suspected that sprouted grains may be present in the sample/load; and/or
- The sample/load appears to have been affected by weather (e.g., rain).

Industry should note:

- If a sample/load contains visually sprouted grain and a reference method is not conducted, there will be a risk of that grain not meeting contractual specifications when outloaded (e.g., supplied to a customer/end-user).
- There will not always be a strong correlation between the percentage of visual sprouting and the FN/RVA test results, even when the visual assessment is being performed by highly trained and experienced personnel.
- Sound, non-sprouted grain can still have a low FN/RVA result due to localised seasonal conditions during crop growth and ripening.
- Some varieties of grain are known to give inherently low FN/RVA results, which may become more apparent when they are grown under certain conditions.
- Different varieties will vary in their tolerance to pre-harvest sprouting in the field.
- Sprouted grain that has been artificially dried may have a high FN, such grain is rejectable in milling grades under GTA Wheat Trading Standards.

3.4 Regulatory Controls

There are no regulatory controls for the assessment of visually sprouted grain, or for the use of the Falling Number unit or Rapid Visco Analyser in Australia.

The regulatory body, being National Measurement Institute (NMI), has determined at this point in time that “such controls are not feasible”.

3.5 Methods of Analysis

There are generally two recognised methods for the assessment of sprouted grain or determining the impact on quality associated with this parameter:

a) Visual - The visual detection and quantification (counting) of sprouted grains in the grain sample. Sprouted grain counts are expressed as a percentage by count.

b) Reference Methods – In Australia the Falling Number method plus the Rapid Visco Analyser for barley are the reference methods for the assessment of sprouted grain in wheat and barley. In Section 5 of relevant cereal Trading Standards booklets (e.g., wheat), the reference methods for each unit are documented. Refer to the GTA website for details at http://www.graintrade.org.au/commodity_standards.

c) The FN and RVA methods are internationally recognised and in GTA Trading Standards the FN or RVA result always over-rides the visual assessment result.

The FN result for two parcels of grain mixed together cannot be averaged based on the tonnage those samples represent, as there is not a linear relationship between the level of weather damage and the number of seconds the test takes. Instead, a formula using the Perten Liquefaction Number must be used. See www.perten.com.
There may be a range of commercially available equipment brands to conduct FN and RVA testing. All equipment should be fully evaluated prior to and post purchase and prior to use.

3.6 Field Assessment

As noted above, assessment of grain may occur either visually or using a reference methods FN and RVA.

3.6.1 Load by Load Assessment

Where visually sprouted grain is detected, depending on the commodity:

- Assessment of quality using a reference method on a load by load basis is preferred.
- The GTA Trading Standards recommend that a FN or RVA test is done on a load by load basis.

3.6.2 Running Sample Assessment

For assessing sprouted grain in situations where a FN or RVA unit is not available at a grain receival site for load by load testing, running sample assessment involving the use of the FN machine or RVA unit to monitor the 'stack quality' is recommended.

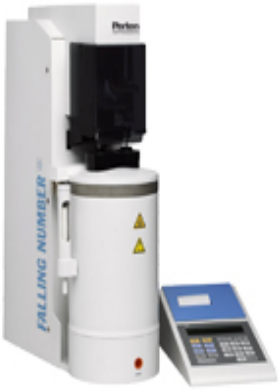
Where relevant, Section 5 of the Trading Standards (e.g., wheat) contains details of a method that may be used. Refer to the procedure titled "Defective Grain Assessment of Sprouted Grain – Field Evaluation". This procedure lists options for testing on a running sample basis (or an alternative procedure).

Industry should note:

- Sprouted grain assessment in the field using this method may be relatively inaccurate if not conducted correctly.
- There are field test kits available that may approximate the FN value and assist in these situations. These may be more accurate than a simple visual assessment in estimating weather-damage enzyme levels in the grain.

3.6.3 Assessment Equipment

Pictured below is some of the equipment used for Sprouted grain assessment:



When using this equipment, industry is strongly encouraged to:

- Service the equipment a minimum of once a year (e.g., immediately prior to harvest)
- Train staff in the correct method of use
- Regularly monitor the condition of all equipment
- Audit results obtained via provision of samples to third parties or internal assessment

3.6.4 Overseas Methods of Assessment

Sprouted grain and/or FN are a quality parameter listed in many international grain standards. Methods of analysis may differ from Australia but in general the main processes and equipment for reference assessment are similar.

The major difference between Australia's and many overseas methods is that Australia does not adjust the weight of flour used in a FN test based on the moisture content of the grain or the elevation above-sea level where the sample is assessed.

Industry should note that generally marketing contracts do not stipulate a method to be used for assessing sprouted grain via the FN unit.

3.7 What Errors can occur during Assessment

There are many errors that may occur when assessing a sample for sprouted grain, whether using the field or reference method.

FN tests are likely to be far more prone to sampling errors than other quality tests performed on a truckload of grain, because sprouted and non-sprouted grain cannot be blended evenly and an average FN result obtained. Loads where sprouted and non-sprouted grain has been deliberately layered or blended have the risk of lowering the quality of the entire parcel of grain.

Apart from sampling, any physical or chemical testing procedure will be influenced by things such as operator training and technique, general cleanliness of the testing area, purity of reagents (such as water), temperature and other environmental factors. One of the manufacturers of FN machines, Perten, has published a number of methodology check points (refer www.perten.com) that describe some of the potential sources of error.

Potential errors when assessing sprouted grain with an impact on the result obtained may include the following:

Procedure	Potential Impact on Result Obtained		Potential Resolution
	Higher	Lower	
General - All Methods			
Sub-sample to be used for assessment not representative of grain parcel	Y	Y	Re-sample and sub-divide sample following industry standards
Although sample contains a large amount of 'pin holes', a potential precursor to sprouting, reference method testing not done	Y		Conduct a reference method test such as FN to determine the quality of grain
Although sample contains a large amount of 'knocked off germs', a potential indication that sprouting has occurred and shoots were knocked off during the harvesting and handling operation, reference method testing not done	Y		Conduct a reference method test such as FN to determine the quality of grain
Grain is received on basis of visual sprouted grain assessment without reference method testing done	Y	Y	Conduct a reference method test such as FN to determine the quality of grain
Falling Number (FN) Unit Operation			
FN unit not maintained or serviced	Y	Y	Service annually before main usage, such as harvest
FN unit not calibrated	Y	Y	Re-calibrate using manufacturer guidelines. Follow written procedures for equipment maintenance operating at site
Grinder used to obtain flour grist not maintained or serviced	Y	Y	Service unit annually. Follow written procedures for equipment maintenance operating at site
Grinder sieve apertures are worn and therefore not the correct specifications	Y	Y	Replace sieve. Follow written procedures for equipment maintenance operating at site
Grinder contains residue from previous sample	Y	Y	Clean grinding chamber, cyclone and filter bag on a regular basis and more frequently if poor quality grain is assessed (e.g., after every test). Tap cyclone with plastic donger after each grind to remove residue

Procedure	Potential Impact on Result Obtained		Potential Resolution
	Higher	Lower	
Grinder contains residue from previous sample	Y	Y	Clean sample collection container after each test
FN equipment (test tubes, plungers, stoppers etc.) contain residue from previous sample	Y	Y	Thoroughly clean and remove all residue after each test and prior to using again
Insufficient amount of grain ground in grinder	Y	Y	Grind adequate amount of whole grain, using a recommended minimum of 250grams. Follow written procedure for equipment use
Ground sample not mixed prior to weighing flour sub-sample	Y	Y	Mix thoroughly prior to obtaining sub-sample for testing
Incorrect weight of ground sample used for assessment, due to balance not accurate, ground sample holder not tared or ground sample remains in funnel when pouring into test tube	Y	Y	Obtain the required 7grams of flour. Check balance operation and adjust if necessary. Check funnel aperture for any residue flour
Distilled water not used in FN unit		Y	Re-fill unit with distilled water
Water in FN unit not boiling		Y	Visually inspect water to ensure boiling before inserting tubes. Ensure FN unit operating correctly
Insufficient water in FN unit	Y	Y	Re-fill. Inspect regularly during use. Consider use of cooling tower to lessen evaporation
Improper water used in test tube	Y	Y	Use distilled water only
Distilled water to be placed in test tube is at incorrect temperature	Y	Y	Temperature must be as close as possible to 22^{o}C
Lesser amount of distilled water placed in test tube	Y	Y	Obtain 25ml of distilled water using appropriate measuring or dispenser device. Follow written procedure
Ground sample and distilled water in test tube not thoroughly shaken or not shaken for sufficient period		Y	Shake vigorously. Obtain automatic shaker. Visibly inspect each tube before placing in FN unit
Ground sample remains on bottom of stoppers after shaking test tube	Y	Y	Wipe residue remaining on the bottom of stoppers onto the test tube
Residue on side of test tube not pushed into flour/water mixture in test tube after shaking is completed	Y	Y	Push residue down into test tube. Follow written procedure
Plunger bent, broken, not correct weight	Y	Y	Replace plunger. Check equipment prior to using
Time between placing ground sample into distilled water and inserting into FN unit too long	Y	Y	Insert as quickly as possible. Follow written procedure
Visual Assessment			
Insufficient time taken to view entire half litre sample, resulting in sprouted grains being undetected		Y	Follow correct procedure. Re-train staff if required
Operator not adequately trained to detected sprouted grain, or simply cannot visually see it		Y	Re-train staff if required. Ensure staff competent
Reference material, including Visual Recognition Standards Guide, not used or referred to during analysis	Y	Y	Utilise and prominently display appropriate material. Refer to material regularly

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Procedure	Potential Impact on Result Obtained		Potential Resolution
	Higher	Lower	
Sample not assessed under conditions of good lighting		Y	Replace lighting to ensure "good natural" lighting available. Use magnification lamp
Split germs not detected as these were thought to be shadows		Y	Re-train staff. Use magnification lamp. Ensure staff are competent.
Running Sample Assessment			
Samples taken infrequently or representing a large tonnage received, resulting in large tonnage received prior to receipt of reference method result		Y	Increase frequency of sampling. Reduce time taken between assessment & notification of results
Too long a period between collection of running sample and receipt of reference method results, resulting in large tonnage received using outdated assessment criteria		Y	Increase frequency of sampling. Reduce time taken between assessment and notification of results
Adjustments to visual sprouted grain count versus reference method result does not provide sufficient flexibility to prevent receipt of out of specification product, resulting in grain that fails reference method tolerance in standards		Y	Review and revise procedure. Increase frequency of sampling. Reduce time taken between assessment and notification of results. Commence load by load testing
Large tonnage received using outdated assessment criteria before the next reference method result is obtained, as industry aware of the length of the delays of receiving this data at the receival site		Y	Review and revise procedure. Increase frequency of sampling. Reduce time taken between assessment and notification of results. Commence load by load testing
The tolerance for sprouted grain for the first day grain is delivered after a rain event is incorrectly set by the receival agent (not set for example at a conservative level to protect the integrity of the stack), resulting in initial tonnage received out of specification		Y	Review and revise procedure
Level of sprouted grain visually able to be received set too conservatively, resulting in some grain rejected or downgraded (i.e., has a high FN that may have met the standard for that grade)	Y		Review and revise procedure
Adjustment of visual tolerance for sprouted grain adjusted too slow, resulting in some grain rejected or downgraded that could have been received (i.e., has a high FN that may have met the standard for that grade)	Y		Review and revise procedure. Reduce time taken between assessment and notification of results. Commence load by load testing

4. Impact of Incorrect Assessment & Potential Actions to Rectify

There can be significant consequences arising from incorrect assessment or a dispute between two parties on results of a sprouted grain assessment. To minimise the occurrence of such events, a range of measures as outlined in this TGD can be undertaken.

Other measures include:

- Verifying all sampling and testing equipment pre harvest
- Ensuring a representative sample is taken for assessment (e.g., sampling procedure followed, sampling equipment not contaminated with prior sample)
- Routine collection of audit samples, and cross-checking results with other parties (e.g., laboratory using a reference method)
- Documenting procedures involved in the sampling and assessment of grain (e.g., as part of the storage operating procedures for a receival site)
- Checking existing instruments to ensure they continue to operate as per their specifications and intended purpose. Damaged equipment should be inspected prior to commencement of grain testing (e.g., FN unit should not be damaged in any way)
- When upgrading or purchasing new equipment, only purchase suitable instruments and seek certificates from the suppliers that equipment meets any industry or international standards
- Ensure all staff are adequately trained in the use of equipment and that training is ongoing to ensure staff are deemed competent at all times (e.g., annual refresher training)
- Monitor the quality of grain received, stored throughout its storage period and prior to or on outturn (e.g., despite "no sprouted grain received" conduct FN tests on all running samples, inspect grain routinely during storage and test prior to or on outturn)
- Recognise that quality may change in storage despite storage under optimal conditions (e.g., FN may increase over time in storage)
- Retain samples of grain received and outturned for assessment in a dispute situation
- Have a documented dispute assessment procedure that outlines the processes to be followed when a result obtained is disputed. In the case of sprouted grain:

    - Consider allowing a re-test if results are within a particular tolerance from the minimum standard (e.g., within 10% of the limit)
    - Consider the method of obtaining a further sample to conduct a re-test (e.g., from the sample bucket, re-probe the truckload tendered for delivery, sub-divide sample received from the other party)
    - Consider which result following a re-test is to apply (e.g., average of both results, accept the higher result, accept the last result)
    - Consider adoption of other measures such as allowable tolerances where the potential impact is fully known (e.g., within 10 seconds of the tolerance)
    - Investigate all methods and procedures associated with the test, including those of the other party involved in any dispute. This includes equipment used, sampling method, monitoring of the equipment, method of analysis (e.g., visual v FN), staff training etc. as outlined in this TGD.