



Falling Number and deoxynivalenol (DON) as potential official grain grading factors

Discussion document
Canadian Grain Commission

March 11, 2019

About the Canadian Grain Commission

The Canadian Grain Commission is a federal department. We administer and enforce the Canada Grain Act and the Canada Grain Regulations.

Under the Act and Regulations, we establish and maintain Canada's grain quality standards. We also regulate the grain industry to protect producers' rights and to ensure the integrity of grain transactions.

Because of our programs, shipments of Canadian grain are safe, reliable, and certified for quality and quantity, providing a dependable commodity for international and domestic customers.

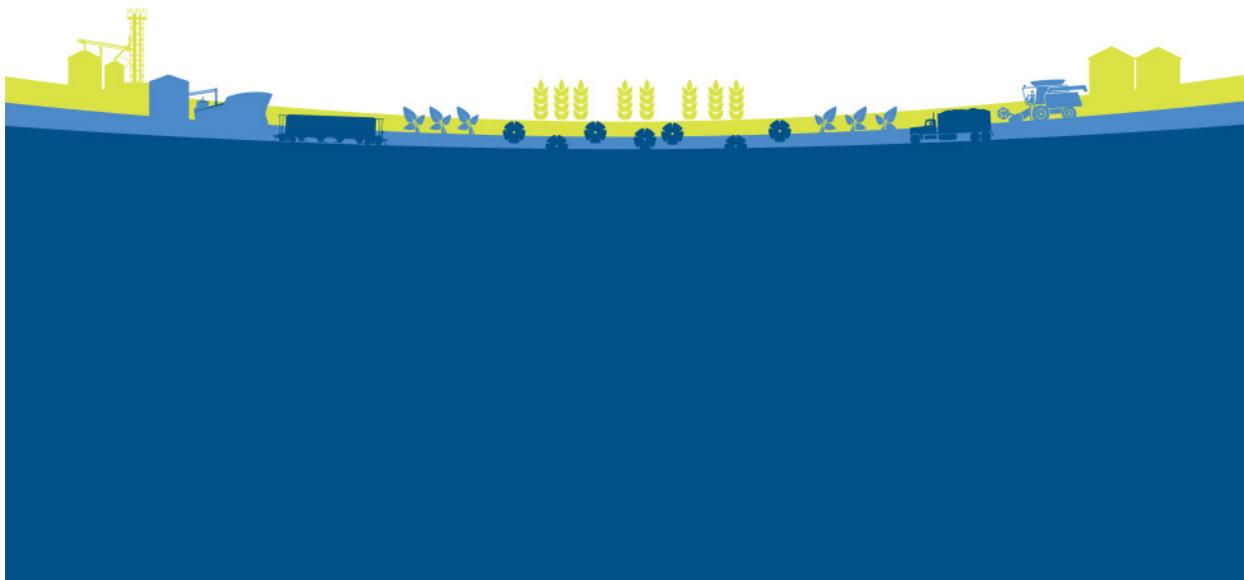


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1. Introduction

Canada is known around the world for the quality, consistency, and reliability of its grain and grain products. The Canadian Grain Commission is committed to a grain grading system that reflects the needs and concerns of all parts of Canada's grain sector, from grain producers to exporters and processors, while maintaining the standard of excellence for Canadian grain.

Advances in technology and analytical testing now provide the opportunity for grain buyers to purchase grain based on specific quality characteristics that can be verified through analytical testing in addition to, or rather than, through visual grading. Many transactions now include payment or discount based on specifications that are important to grain buyers and customers. These specifications are either in lieu of, or in addition to, the grain grading factors detailed in Schedule III of the [Canada Grain Regulations](#) and the [Official Grain Grading Guide](#). Specifically, the importance of Falling Number and deoxynivalenol (DON) testing has escalated due to increasing buyer demand for wheat purchases by specification

Currently, Falling Number and DON are not official grading factors in the statutory Canadian grading system for any type of crop, including wheat. However, they increasingly play a critical role in grain contracts and the assessment and price that grain sector participants, including producers, receive for their grain.

While Falling Number and DON are two prominent examples of the importance of objective specifications in the grain sector, it is likely that other specifications will be introduced and that the reliance on analytical testing will continue to grow as grain quality science advances. To the extent these quality specifications are also assessed by visual inspection, this trend presents the question of whether analytical assessments should be incorporated into the official grading system, or even replace the associated visual factors altogether. While the accuracy of analytical tests is better than that of visual inspection, other considerations (for example speed, cost, and availability of tests) need to be fully understood prior to making broad-based changes to the grading system.

A key priority for the Canadian Grain Commission is to provide relevant, efficient and innovative programs and services. Given our long-term commitment to modernizing the grain grading system and improving producer protection, we are considering changes to the grading system that will better reflect the operational realities of grain trading. Specifically, we are looking at whether to provide more efficient and precise assessments of grain quality and how best to address Falling Number and DON specifications in the context of the Canadian grain grading system.

2. Purpose of this discussion document

With this document, we are asking for input from stakeholders on whether to implement Falling Number and DON as official statutory grain grading factors, and what the impacts would be if these changes were implemented. This document explains:

- how to submit input and how your input will be used
- the current status of Falling Number and DON in the grain sector
- a potential approach for implementing Falling Number and DON as official grain grading factors

3. Providing your input

We want to hear your views:

- about the potential approach outlined in this document
- on how this approach would impact your business
- on other potential methods for addressing Falling Number and DON in the official grading system

3.1 How to submit your input

The Canadian Grain Commission must receive your input in writing between March 11, 2019 and midnight on May 10, 2019 for consideration within this process.

You are invited to submit input in the official language of your choice by:

- email to discussions@grainscanada.gc.ca
- fax to 204-983-2751
- mail (including a return address) to:

Falling Number and DON Comments
Canadian Grain Commission
600-303 Main Street
Winnipeg, MB R3C 3G8

Alternatively, we invite stakeholder organizations to request a meeting with the Canadian Grain Commission to provide feedback in person. If your organization is interested in doing so, please submit a meeting request including the details outlined below.

The Canadian Grain Commission recommends that you include the following information along with your input:

- your full name
- your phone number
- your complete mailing address
- your email address
- the reason for the input

- information on the organization you represent, if any
- any additional information that is relevant

If you are submitting a meeting request to provide direct input, please provide the following information:

- your full name
- the name of the organization you represent
- your organization's phone number
- your organization's complete mailing address
- your organization's email address
- the approximate date(s) when your organization wishes to meet with the Canadian Grain Commission
- any additional information that is relevant

This document is also available on our website www.grainscanada.gc.ca. If you have any questions, please contact us.

Thank you in advance for your contribution.

3.2 How we use your input

We will study your input along with other considerations such as:

- input received from other stakeholders on the same subject
- consistency with the Canadian Grain Commission's mandate to establish and maintain standards of quality for Canadian grain, regulate grain handling in Canada, and to ensure that grain is a dependable commodity for domestic and export markets
- the legal or policy implications of your proposals within the framework of the Canada Grain Act if applicable
- consistency with broader Government of Canada policies and priorities

We are committed to an open and transparent process. We will summarize all input received in a report following the comment period. To maintain your confidentiality, names of individuals will be protected in accordance with the Privacy Act.

4. Background information

4.1 Legal authorities

The Canadian Grain Commission's regulatory authority to establish grades of grain, and the specifications for those grades, originates in section 16(1) of the [Canada Grain Act](#) as follows:

16(1) The Commission may, by regulation, establish grades and grade names for any kind of western grain and eastern grain and establish the specifications for those grades and set out a method or methods, visual or otherwise, for

determining the characteristics of the grain for the purposes of meeting the quality requirements of purchasers of grain.

Section 16(2) limits the coming into force of grading regulations to the start of a crop year, and section 16(3) requires the Commission, where possible, to minimize reductions in value of existing grain. Within this legal framework, the Canadian Grain Commission may exercise wide discretion to determine grading factors, their application, and the grades to which they are applicable.

In addition, the Canadian Grain Commission can prescribe methods for determining grain characteristics. We may also establish a grading factor applicable to some, but not all, grades established for a grain class. For example, minimum protein content and minimum hard vitreous kernels in wheat, minimum test weight in flax and triticale, and color in lentils.

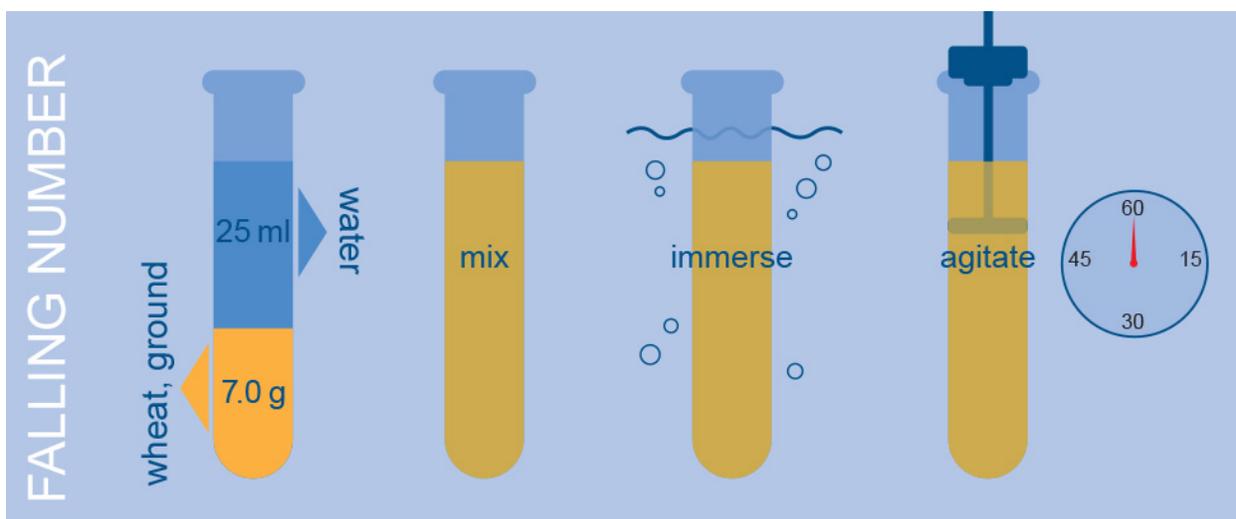
Standards committees

The Canada Grain Act requires that the Canadian Grain Commission establish both a Western and an Eastern Standards Committee. Standards committees recommend specifications for grades of grain, and select and recommend standard samples for consideration in Commission decision-making. They base their recommendations on scientific evidence, and careful study of grading issues. Their recommendations relate to market requirements for end-use quality to ensure that any grading system changes reflect the interests and concerns of all parts of the Canadian grain sector. The Canadian Grain Commission reviews the Canadian grading system annually and can make adjustments based on recommendations from the standards committees.

4.2 Sprout damage and Falling Number

The Falling Number test is an internationally standardized method for determining the amount of sprout damage in wheat caused by the enzyme alpha-amylase. Alpha-amylase breaks down wheat starch in the kernel into sugars so that the germinating kernel has an energy source. Sound grain has minimal enzyme levels. However, in sprout-damaged wheat enzyme levels rise dramatically in response to hormones triggered by germination. Activity can rise from 10 units to over 50,000 units depending on the stage or severity of the sprout damage.

The Falling Number test uses 7.0 grams of ground wheat (adjusted for moisture) mixed with 25 millilitres of water to form a slurry in a test tube. Once mixed, the test tube is immersed in boiling water and the slurry is agitated for 60 seconds using a plunger system. At 60 seconds, the plunger is drawn to the surface and released.



The Falling Number value represents the time in seconds it took the plunger to fall through a specific distance. The more alpha-amylase there is due to sprouting, the less viscous the slurry is. The plunger falls more quickly, resulting in a lower Falling Number. Likewise, the less alpha-amylase there is due to sprouting, the more viscous or thicker the slurry is. The plunger falls more slowly, resulting in a higher Falling Number.

Falling Number is a relatively accurate indicator of germination and, in turn, the end-use quality of wheat. A Falling Number value of around 300 seconds indicates wheat is sound and satisfactory for most milling and bread baking processes. However, as sprout damage increases in a sample of wheat, its relationship to Falling Number is much more variable. In practical terms, if Falling Number is not satisfactory, bread dough will be too sticky and hard to handle and baked loaves will have open holes, and be crumbly, deformed and hard to package. Production problems will occur with pasta such as uneven extrusion, stretching, and cracking. Upon cooking, pasta will become soft and mushy.

Falling Number is currently not an official grading factor listed in the Canada Grain Regulations or the Official Grain Grading Guide. Instead, the Canadian Grain Commission's visually assessed sprouted and severely sprouted official grading factors act as rapid, low-cost proxies for alpha-amylase activity/ or Falling Number value.

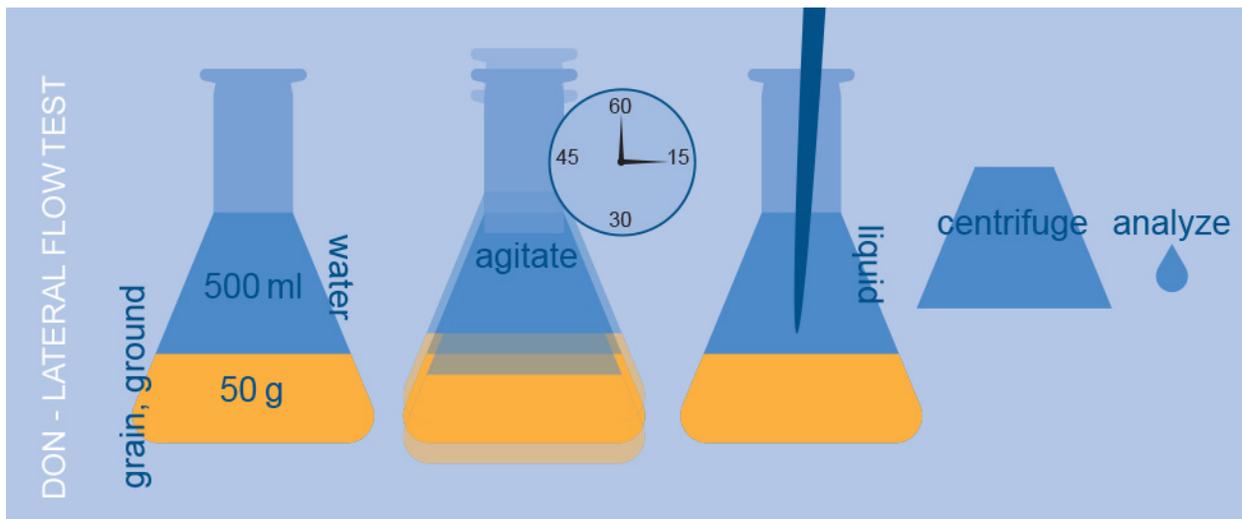
However, the grain industry regularly uses Falling Number as a specification in sales contracts with buyers of Canadian wheat, and it often replaces visual assessment as the primary measure of sprout damage in a wheat delivery. Visual assessment of sprout damage confirms that germination has started, but does not provide an indication of how far advanced the germination process is, and subsequently does not reflect actual alpha-amylase levels. As such, visual assessment may not provide enough accuracy to meet defined grain contract specifications as it is only an approximation of the relationship between sprout damage and Falling Number.

4.3 Fusarium damage and Deoxynivalenol (DON)

Deoxynivalenol (DON), commonly referred to as vomitoxin, is a mycotoxin that may be produced in grain infected by Fusarium head blight, depending on the species and chemotype. Fusarium head blight is a fungal disease that can infect wheat, barley, oats, rye, and corn. Although there are many species causing Fusarium head blight, *Fusarium graminearum* is the

most important species in Canada and has the greatest impact on yield and grain quality. Fusarium head blight results in the production of damaged seeds called FDK (Fusarium-damaged kernels) that appear shriveled and chalky white.

DON levels in grain samples can be tested using enzyme-linked immunosorbent assay (ELISA), mass spectrometry, and fluorescence or lateral flow strip technology. Both the ELISA and mass spectrometry methods are time-consuming and require expensive laboratory equipment. Lateral flow strip technology is a simple, fast and cost-effective way to perform a DON test with quantitative or qualitative results. In general, a lateral flow test requires 50 grams of ground grain to be extracted with 500 millilitres of water for 15 minutes under continuous agitation. The liquid is drawn off, centrifuged, and a small amount is analyzed. This test is an immunological assay that relates the amount of DON present to the amount of color developed on the test strip as read by a specific wavelength detector.



DON is currently not an official grading factor listed in the [Canada Grain Regulations](#) or the [Official Grain Grading Guide](#). Instead, the Canadian Grain Commission assesses the impacts of Fusarium, including DON, through visual inspection of FDK, and sets official grade tolerances for FDK to manage DON levels in bulk grain shipments. These tolerances take into account many factors including growing conditions, end-use characteristics, marketing considerations, varieties grown, and current scientific research on the relationship between DON levels and FDK.

4.3.1 Grain and food safety

DON is a critical grain and food safety issue. The [Codex Committee on Contaminants in Food](#) develops and proposes international food safety standards and codes of practice. This Committee has set DON maximum levels at 2.0 mg/kg for cereal grains, including wheat, maize and barley, which are destined for further processing to help reduce DON levels prior to use in food products.

Canada's [Food and Drugs Act](#) currently identifies DON in its List of Maximum Levels for Various Chemical Contaminants. However, there are no established limits for DON in most raw cereal grains or finished grain products in Canada. The only established limit is for 'uncleaned soft wheat in non-staple foods' which is set at 2000 parts per billion. However, this limit is currently under review.

Although visually assessed FDK is used to provide a general level of grain safety assurance with respect to DON, this relationship does not precisely predict DON levels in individual grain samples and may not ensure sufficient accuracy for grain contracts with defined DON specifications. The only way to detect a specific DON level is through actual testing using lateral flow strips or other laboratory methods.

4.3.2 End-product functionality

Existing official FDK levels (%) are set in terms of grain and food safety impacts and are based on the relationship between Fusarium damage and DON levels. However, certain species of Fusarium head blight fungi do not produce DON, but do secrete enzymes, known generically as proteases, that can have a detrimental impact on the end-use functional properties of wheat, barley and oats. Proteases attack key proteins in flour that are responsible for dough quality. Elevated levels of FDK can reduce a wheat sample's gluten strength, which directly affects bread loaf volume and texture. This can occur even where there is no DON present in the grain.

4.4 Other exporting countries

4.4.1 United States

The [United States Grain Standards Act](#) authorizes the United States Grain Inspection, Packers and Stockyards Administration to establish official marketing standards for grains and oilseeds. Falling Number is not currently an official grading factor in the United States. However, Falling Number is one of the quality assessment specifications that may be required as part of grain sales contracts.

The Falling Number assessment required as part of sales contracts provides options such as Falling Number minimum 300 cargo composite, Falling Number 300 subplot average and Falling Number no subplot under 300 seconds.

Sprouted kernels are not a separate official grading factor, but are included as part of the official grading factor Damaged Kernels - kernels, pieces of wheat kernels, and other grains that are badly ground-damaged, badly weather-damaged, diseased, frost-damaged, germ-damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged, or otherwise materially damaged. However, as part of contract specifications, soundness-limits can be placed on specific types of damage such as sprout.

DON is not currently an official grading factor in the United States. However, DON is one of the quality assessment specifications that may be required as part of grain sales contracts. Under the United States Grain Standards Act, the United States Department of Agriculture does not require domestic or export shipments to be tested for DON. Instead, DON testing services for barley, corn, oats and wheat are offered upon request for a fee for both domestic and export grain.

4.4.2 Australia

[Grain Trade Australia](#) provides formal commodity trading standards, and develops and publishes trade rules and standardized grain contracts. Their role is to ensure the efficient facilitation of commercial activities across the entire Australian grain supply chain. In addition to overall Trade Rules, Grain Trade Australia publishes annual Grain Trading Standards, including official Cereal Standards for use by industry.

Falling Number minimums (in seconds) and Sprouted maximums (% by kernel count) are both included as grading standards in the 2018/19 Wheat Statement of Standards. However, a statement is included that the Falling Number result overrides the visual assessment for Sprouted grains. Falling Number minimums are provided for each class and grade of wheat and vary from 200 seconds to 350 seconds. A Falling Number Assessment – Reference Method is also included in the Wheat Trading Standards.

DON is not currently an official grading factor in the Grain Trading Standards. However, DON is one of the quality assessment specifications that may be required as part of grain sales contracts. Similar to Canada's official grade tolerances for visual assessment of FDK, 'white grain disorder/head scab' is a grading standard included in Australia's Wheat Statement of Standards designed to minimize DON levels in bulk grain shipments.

5. Potential approach for adding Falling Number and DON into the grading system

The Canadian Grain Commission is committed to improving both the effectiveness and responsiveness of Canada's grain grading system to meet the needs of all parts of the grain sector including producers, exporters, processors and buyers of Canadian grain. As a basis for starting stakeholder discussions on whether and how to implement Falling Number and DON as official statutory grading factors, we are considering the following potential approach.

Falling Number

- Add Falling Number as an official grading factor, providing for objective assessment of alpha-amylase levels within the grading system. Establish one specification (minimum level) that applies to all grades within a class. A minimum Falling Number level will be particularly important in crop years with increased sprouting issues.
- Consider removal of the existing sprouted and severely sprouted kernel official grading factors, given Falling Number measures the same end use quality factor.

DON

- Add DON as an official grading factor to allow for a more accurate assessment of grain safety. Establish one specification (maximum level) that applies to all grades within a class.
- Retain Fusarium-damaged kernels (FUS DMG %) as an official grading factor, given Fusarium has other significant end-use quality impacts beyond the associated DON levels.

Falling Number and DON grading factors would not take precedence over other official grading factors. Other grading factors that affect the final grain grade would continue to apply (e.g. mildew, frost, HVK).

6. Considerations

We value your input on the potential approach we have outlined and invite further suggestions on other potential methods for addressing Falling Number and DON in the grading system. Annex One provides a list of questions to consider as part of your organization's feedback. You may also want to consider the following implications of including Falling Number and DON in the official grading system when providing your input.

Grain grading system modernization

- There is a place for both visual grading and for analytical testing within the Canadian grain quality assurance system. Visually based grades are low-cost, rapid, and effective. Visually based grading allows producers and grain buyers to quickly assess grain for certain quality features and make binning and segregation decisions. However, it sometimes relies on visual proxies for specifications that can be scientifically tested, as in the case of Falling Number and DON.
- Inclusion of more objective grading factors and analytical testing in the official grain grading system would allow for greater precision in assessing quality factors, and serve to modernize the grain quality assurance system.

Operational feasibility

- *Current approaches.*
 - Applying a minimum Falling Number specification to all grades is similar to the current grading procedure for protein in western wheat classes.
 - The Canada Grain Act and the Canada Grain Regulations do not establish the process by which grain is to be graded, or any obligation for each and every factor established for a class of grain to be graded. As such, grain companies are not required to assess every official grading factor for every transaction when purchasing grain from producers. Persons grading grain are at liberty to, for example, evaluate factors in any order and cease any further evaluation when one factor is determinative of grade. For example, even if DON were to become an official grading factor there would be no obligation to test for DON if it is considered a non-issue for a particular region or crop year and/or grade is determined by other factors.
- *Testing methodology and process.*
 - Standard testing equipment, guidelines or proficiency testing may be necessary to ensure repeatability within the testing chain.
 - The use of multiple Falling Number machines, operators and testing environments can all contribute to variable Falling Number test results.

- Advances in technology have made analytical testing directly for DON faster and less expensive.
- Any new technology based analyses that affects the grading system is required to go through the [Technology Transfer Template](#).

- *Sampling methodology and procedures.*

- A process for due diligence at all operational levels in the grain handling and quality assurance system would be required to ensure a degree of uniformity in sample size and the sampling process to avoid sampling inconsistencies and improve test repeatability within the testing chain.

Grain buyer impacts

- If grain companies are not currently testing for Falling Number and DON when required in a grain sales transaction, increases in costs may result.
- If Falling Number and DON were added as official grading factors, they would be eligible for 'appeal of official inspection' under the Canada Grain Act. This may affect the time needed for testing, the number of tests required, sample retention sizes, and sample storage, etc.

Producer impacts

- Adding Falling Number and DON as official grading factors may result in greater price transparency for producers. Producers have no visual means of assessing Falling Number or DON values themselves, but these specifications often play a critical role in the assessment of, and price received for, grain deliveries.
- Adding Falling Number and DON as official grading factors would enable these factors to be reviewable under the 'subject to inspectors' grade and dockage' clause of the Canada Grain Act. 'Subject to inspectors' grade and dockage' allows the Canadian Grain Commission to determine the factors, in the event of a disagreement between licensed primary elevators and producers, using analytically determined data from representative samples.
- Based on a program evaluation of the Canadian Grain Commission's Harvest Sample Program, producers identified Falling Number and DON values as the most important additional information that could be received through this program. The Canadian Grain Commission now provides Falling Number and DON values on every wheat sample submitted. DON and Falling Number continue to be critical issues for producers.

Trade impacts

- Codex DON maximum levels are set at 2.0 ppm. However, some buyers and countries will not accept anything over 1.0 ppm. Other buyers will accept DON levels above 2.0 ppm. Determining an appropriate DON level would be required.
- Including Falling Number and DON as official grading factors may better position Canada relative to other grain trading countries on the international market and increase market access.

7. Next steps

The Canadian Grain Commission will compile the input we receive and publish a summary on what we heard after the discussion process concludes. In order to determine the most effective path forward, we will consider and assess all feedback including in terms of relevant legal and operational requirements and value-added potential for the grain sector. Prior to any grading factor changes, the Eastern and Western Standards Committees will be required to conduct a careful review and consideration.

In addition, Budget 2018 identified the agriculture and agri-food sector as one of three areas to pursue targeted regulatory reviews to support the Government's pursuit of a regulatory reform agenda focused on 'supporting innovation and business investment with a goal to make the Canadian regulatory system more agile, transparent and responsive'. As the Canadian Grain Commission is in the midst of reviewing the Canada Grain Regulations as part of the Budget 2018 regulatory review process, feedback from this discussion will also be considered as part of the overall regulatory review.

Annex One – Questions for Consideration

Please use the following list of questions as a guide when providing your input. Responses to all questions are not required.

1. Do you or your organization currently use Falling Number and DON as specifications when buying or selling grain? If so, how often? What levels do you specify?
2. How do you currently test for Falling Number and/or DON?
3. Should we keep Fusarium-damaged kernels (FUS DMG %) and sprouted and extremely sprouted kernels as official grading factors even if we also add DON and Falling Number as official grading factors? Why?
4. If Falling Number and DON are added as official grading factors, should these factors apply to all types of grain? If not, what types of grain should these factors apply to (e.g. wheat, wheat and barley, etc.)?
5. How would the outlined potential approach affect you or your organization?
 - a. Are there benefits for you or your organization if Falling Number and DON are included as official grading factors? Are you able to quantify these benefits?
 - b. Would including Falling Number and DON as official grading factors increase costs for you or your organization? By how much? What would drive these cost changes?
 - c. What are the risks to you or your organization if Falling Number and DON are not included as official grading factors? What are the risks to you or your organization if they are included?
6. Would including Falling Number and DON as official grading factors increase the marketability of your grain or increase your profits?
7. How do you think that including Falling Number and DON as official grading factors would affect the dependability of Canadian grain, if at all?
8. Do you think including Falling Number and DON as official grading factors would affect grain prices? If so, how?
9. Do you have input on potential minimum and/or maximum Falling Number and DON levels?
10. The Canadian Grain Commission now provides Falling Number and DON values are on every wheat sample submitted by producers through the our Harvest Sample Program. Would producers of other grain types also benefit from receiving this information?
11. Do you have a proposal for an alternative approach for including Falling Number and DON in the Canadian grain quality assurance system that would reflect the importance of these factors in grain transactions?