**QUALITY OBJECTIVES FOR WESTERN CANADIAN WHEAT CLASSES**

**VERSION: August 2015:**

**Prepared for review by the Quality Evaluation Team (QET) PRCWRT,**

Wheat varieties registered for production in western Canada are classified by the Canadian Grain Commission (CGC) into an appropriate market class. This allows for orderly segregation of wheat into classes that meet customer expectations of end-use performance. The CGC uses the QET’s assessment of candidate cultivars when determining classification of a newly registered variety.

These Quality Objectives are intended as guidelines for wheat breeders when determining the appropriate registration trial for submission and testing over the trial period. Candidate lines are tested and compared against approved check varieties for the trial and should aim to meet the established Quality Objectives.

When evaluating candidate lines from registration trials the QET uses objective assessments as much as possible. Many quality parameters are rated based on objective comparison to the mean values of the approved check variety results, using defined variation from the mean. Check varieties are chosen to represent an acceptable performance range for the desired factors. If objective measures are difficult to incorporate then subjective assessments come from the combined expertise inherent in the QET membership.

For additional information on submission of registration trial material, quality factors to be tested for each registration trial category (class), laboratory testing methodology and reporting of data for quality evaluation please refer to the PRCWRT Operating Procedures, Appendix F (Wheat and Durum: Measurement of Quality Traits).

<http://www.pgdc.ca/pdfs/wrt/PRCWRT%20OPS%20-%20FINAL%20DRAFT%20-%2027%20Nov%202013.pdf>

Detail on class specific Quality Objectives are provided for the following wheat classes.

* Canada Western Red Spring (CWRS) wheat
* Canada Western Amber Durum (CWAD) wheat
* Canada Western Red Winter (CWRW) wheat
* Canada Prairie Spring Red (CPSR) wheat
* Canada Western Hard White Spring (CWHWS) wheat
* Canada Western Soft White Spring (CWSWS) wheat

Note there are no ongoing registration trials for the two classes Canada Western Extra Strong (CWES) wheat and Canada Prairie Spring White (CPSW) wheat.

In July 2015 the Canadian Grain Commission proposed a new western wheat class, Canada Western Interim Wheat (CWIW). The class initially includes three varieties - Faller, Prosper and Elgin-ND. Over the next few years other registered CWRS and CPSR varieties are being reviewed for possible reclassification so registered varieties may be moved to the Variety Designation List for CWIW or other classes. Quality Objectives for the CWIW class have not yet been established.

Candidate spring and winter cultivars intended for the Canada Western General Purpose (CWGP) wheat class as well as entries for rye and triticale classes are not evaluated for functional quality properties.

**Canada Western Red Spring (CWRS) wheat**

CWRS has been a cornerstone of wheat production in western Canada for many decades. The class is recognized worldwide as a high quality milling wheat for many flour applications and has been appreciated for high, functional protein levels, good flour milling yield, low wheat-to-flour protein loss and superior water absorption. The last decade has seen a wider range of quality in CWRS production accompanied by particular concern for unacceptable dough strength properties. Dough strength and mixing tolerance are critical factors for producing high volume, yeast-raised baked products. Variable dough strength may be due to environmental factors as well as farm management practices and these impacts are being investigated. There is also concern the QET evaluation process has allowed varieties with lower dough strength to be classified as CWRS. This has resulted in discussion and review of bake testing methods and inclusion of additional dough rheology tests to assist QET deliberations.

Premium markets for CWRS are looking for wheat in the top grades and protein levels typically over 13.5% accompanied by traditional “mellow” gluten properties that provide adequate dough strength (resistance) and dough extensibility with superior mixing tolerance levels. High quality CWRS has relatively few competitive alternatives for discerning grain buyers. Lower CWRS grades and protein levels are traded into a wider spectrum of applications and must compete both domestically and in international markets with other Canadian wheat classes or with lower quality wheat available from many origins.

Candidate cultivars should express CWRS quality expectations, as follows:

* **Protein Content, Protein Quality:**
  + CWRS is a high protein milling wheat with typical commercial protein segregations ranging from 12.0% to 14.5% wheat protein content (measured as N x 5.7 at 13.5% moisture level).
  + Protein content is easily measured at early stages of breeding and candidates should express equal or higher protein levels when compared to check varieties. Protein content is an objective measure and levels for candidate cultivars will be assessed against check variety results.
  + A unique property of CWRS varieties is a low protein loss from wheat to flour, typically about 0.5% loss from wheat (13.5% moisture basis) to flour (14.0% moisture basis). Excess protein loss will be flagged.
  + Gluten strength should be adequate for high volume pan-bread production. Gluten strength is a more subjective assessment and is determined through interpretation of various testing methods such as Farinograph, Extensograph or functional bake tests. Ideally, gluten strength properties should be linear across the protein range values.
  + CWRS is used for a wide range of flour products when used as a single component of a mill grist or when blended with wheat of other classes or origins. The high protein and adequate gluten strength of CWRS is a key expectation when used for blending.
* **Milling Quality:**
  + CWRS is a hard wheat that requires suitable tempering (conditioning) to allow optimum flour extraction. Excessive wheat hardness is not desirable as it can result in roller mills producing elevated flour starch damage that can impact milling yield, flour ash content and flour water absorption levels in commercial processing. Kernel hardness is a selectable genetic trait that can be influenced by the environment, such as when hard, flinty kernels develop due to excessive heat stress.
  + At optimized commercial mill settings CWRS achieves a high extraction of bright, clean flour with low ash levels. This high extraction potential should still be apparent in small scale test milling where restriction in mill settings may not allow full optimization.
  + Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis. For CWRS wheat, flour yield also is expressed at a constant ash content of 0.50%,
  + Milling quality measures (starch damage, flour milling yield, flour ash) are objective and levels for candidate cultivars will be assessed against check variety results.
* **Flour Water Absorption:**
  + A unique property of milled CWRS flour is high water absorption level allowing full gluten hydration to achieve desirable dough mixing properties. This is partly due to grain hardness but excessive hardness is not desirable. Balanced, high water absorption potential is both a functional and commercial benefit desired by bakers.
  + High flour water absorption in CWRS is a key expectation when used in blended grists.
  + Flour water absorption is an objective measure and levels for candidate cultivars will be assessed against check variety results.
* **End Product Applications:**
  + High quality CWRS flour will meet many processing requirements with a primary application being yeast-fermented, high volume pan-breads whether used alone or in blends. Many dough additives are available to assist bakers to achieve dough strength and tolerance parameters but these cannot fully replace fundamental gluten quality.
  + Flour milled from CWRS wheat is used for various Asian products including noodles with an important factor being colour retention and appearance of noodle sheets Noodle quality measures (water dough colour, yellow alkaline colour, white salted colour) are objective and levels for candidate cultivars will be assessed against check variety results.
  + There is some use of CWRS flour outside of yeast-raised dough applications such as extruded dough products (pasta, snacks), crackers and biscuits but there are no specific quality requirements that have been identified for CWRS to meet in these applications.
* **Grade factors:**

Wheat quality can be affected by environmental factors such as weather, disease or insect damage. Their influence is controlled through wheat grading standards established and monitored by the CGC. Grading factors that impact end use performance include:

* + **Sprout Damage** – excess sprouting of grain will result in low amylograph peak viscosities and low Falling Number levels and can severely impact end product quality. CWRS candidate cultivars should express adequate resistance to sprout damage.
  + **Fusarium** – excess levels of fusarium damaged kernels (FDK) will impact dough strength. As well most fusarium species produce toxins, e.g. deoxynivalenol (DON), that are a health and safety concern. CWRS candidate cultivars should express adequate resistance to fusarium damage.
  + **Midge damage** –Excess levels of midge damage can severely affect bread baking properties. CWRS candidate cultivars should express adequate resistance to midge damage.

**Canada Western Amber Durum (CWAD) wheat**

Durum wheat is the second largest wheat class grown in Western Canada and Canadian durum wheat has enjoyed a large market share in international durum trade for many decades. CWAD is widely used in various products, including long and short dried pasta, fresh pasta, sheeted pasta, couscous and baked bread. CWAD has superior milling quality producing a high yield of semolina with low ash content and speck count, and has high yellow pigment content necessary to produce products with a bright-yellow colour. The high protein content and strong gluten characteristics of CWAD ensures superior pasta cooking quality and good performance in certain products, such as durum bread. Varieties of CWAD must express low cadmium uptake in order to meet international tolerance levels.

Candidate cultivars should express CWAD quality expectations, as follows:

* **Protein content**
  + High protein content is a primary quality factor in many markets using Canadian durum wheat. Registration of high protein lines is an effective way to maintain grain protein content at the highest possible level in a low-input production system characterized by low rates of nitrogen fertilizer application. Protein content is an objective measure and easily determined at early stages of breeding. Candidate cultivars should express equal to higher protein levels when compared to check varieties.
  + Durum wheat with high protein and good physical condition will generally yield semolina of uniform particle size with a minimum number of starchy particles. Protein in semolina facilitates hydration during mixing and provides the structure for pasta. High protein concentration is the prerequisite for superior pasta cooking quality.
* **Gluten strength**
  + The relationship between gluten strength and pasta cooking quality is complex and inconclusive. There is evidence that under high temperature drying conditions, gluten strength has less influence on pasta cooking quality than under low temperature drying conditions. High temperature drying is predominant in today’s pasta industry. CWAD varieties registered since 1997 have significantly stronger gluten strength than earlier varieties. Feedback from the markets has been positive for this increase, although little information is available if this actually resulted in any significant improvement in the texture of cooked pasta.
  + The continuity and strength of the protein matrix formed during extrusion is important in determining the textural characteristics of pasta. It is important to have strong resistance and extensible gluten for CWAD to be suitable for most products in major markets. This has resulted in lower interest in developing Extra Strong-type of durum wheat that possesses strong but less extensible gluten. Cultivars with inextensible gluten have limited applications.
  + The gluten strength characteristics of Strongfield (strong and extensible) have been well received by the markets and represent the target level. Strength in the range of AC Morse is acceptable as a low end. In terms of upper strength, the key is to exclude lines with inextensible gluten properties. The Alveograph P/L value should be lower than that of Navigator. The market demand is limited for extra-strong CWAD.
* **Milling performance**
  + Milling performance is the most important factor that determines the industrial value of durum wheat. The key indicators of milling quality are yields (total and semolina), ash content and speck counts in the finished granular product. Yield is a key indicator of profit for durum mill. There is a legal limit for semolina ash content in some EU countries. Speck count is a deciding factor of consumer acceptance for many durum products. CWAD is well appreciated by customers around the world for its good milling yields and low ash content.
  + Milling quality measures for durum (semolina and total milling yield, semolina ash) are objective and levels for candidate cultivars will be assessed against check variety results. Future registered varieties should maintain or further improve the current milling performance of the check varieties.
* **Pigment content and pigment loss**
  + CWAD varieties produce semolina and pasta products with bright yellow colour, a desirable feature appreciated by customers. Semolina and pasta yellowness is affected by various factors: the yellow pigment content of grain; the oxidative degradation of pigments by lipoxygenase (LOX) enzymes during pasta processing and the processing conditions such as drying temperature, extrusion die design and type.
  + High yellow pigment content is desirable and can be measured at early breeding stages. Elevated redness (a\*) of pasta in some high pigment genotypes is undesirable but increased pasta yellowness will usually compensate for redness in the overall appearance of pasta. Many customers also use Canadian durum for blending with wheat of low pigment to improve colour of semolina and pasta products.
  + Some of the pigments in semolina will be degraded and lose yellow colour during pasta processing through oxidation induced by LOX. Progress in the genetics of LOX has facilitated improvement in developing cultivars with low LOX activity. While high pigment content is the primary factor for superior colour of semolina and pasta, reduction in LOX activity will further improve the colour of pasta products. Candidate lines with low pigment loss will be noted as a positive trait.
* **Cadmium level**
  + High levels of Cadmium (Cd) in cereal grains are a health concern and limits are imposed for international grain trade. Low Cd concentration in durum wheat is mainly controlled by a single dominant gene that is highly heritable. Incorporation of the low Cd allele into cultivars typically reduces the grain Cd by about 50%. Low Cd is mandatory for registration of durum wheat cultivars in Canada.
  + In anticipation of potential tightening of Cd level especially in the EU, further reduction of Cd concentration will better position CWAD in key markets The development of durum varieties with very low Cd is encouraged.
  + Candidate line entries must have Cd levels lower than 100 ppb
* **Grade Factors:**

Durum quality can be affected by environmental factors such as weather, disease or insect damage. Their influence is controlled through grading standards established and monitored by the CGC. Grading factors that impact end use performance include:

* **Surface Discolouration**: - Bright, speck-free semolina is required to give the clean, aesthetic appearance of premium semolina and pasta products. Ergot, smudge, black point, mildew, and midge are the main physical defects associated with surface discolouration and are tolerated in very low amounts in top grades of CWAD. Resistance to disease and insect damage not only prevents loss of yield but also protects grade and quality of durum wheat because of the major impact on speck count. In a fixed and controlled milling environment, semolina speck count depends more on weather and disease impacts to the kernel rather than on intrinsic quality. Speck count in semolina and pasta will not be included as official quality parameters for variety evaluation however data will be provided for consideration when making decisions based on a line’s overall performance.
* **Hard Vitreous Kernels (HVK):** - CWAD varieties demonstrate high levels of HVK, an important commercial measure for semolina yield potential. Late season weathering can result in lower HVK levels and drop grade potential for the crop. CWAD candidate cultivars should express high potential for HVK levels when compared to check varieties.

**Canada Western Red Winter (CWRW) wheat**

CWRW wheat has very good milling properties with high milling yield, good flour color and low flour ash levels. Protein levels in CWRW are mid-range, typically averaging 11.5%. Water absorption in winter wheat is typically lower than CWRS, partially explained due to lower protein levels.

Product applications for CWRW are for lower volume breads (hearth and flat breads), crackers and in blends with stronger wheats for high volume pan bread. CWRW is also ideal for steamed breads and some noodles.

Desire for improved functional quality in CWRW led to reclassification of five CWRW varieties to the Canada Western General Purpose (CWGP) class. These varieties exhibited high yield, superior winter survival and disease resistance but they were lacking in the quality profile that was necessary to develop, promote and market superior quality CWRW varieties for milling use. The remaining varieties in the class provide a strong quality base in which to build market value for CWRW.

Candidate cultivars should express CWRW quality expectations, as follows:

* **Protein Content, Protein Quality**:
  + CWRW is a medium protein milling wheat with a minimum protein requirement of 11.0% (13.5% moisture basis) to be eligible for grades No. 1 and 2. Protein content is easily measured at early stages of breeding and candidates should express high protein levels when compared to check varieties. Higher grain protein in this class is desirable.
  + Current gluten strength targets are acceptable however there has been discussion to increase strength to better compete with stronger US HRW. New (stronger) check varieties will ensure strength is maintained and improved.
* **Milling Quality:**
  + CWRW is a semi-hard wheat that requires adequate tempering (conditioning) to allow optimum flour extraction. The same milling principles explained in CWRS are applicable to CWRW with the same goal of producing bright, clean flour with low ash levels. CWRW has the desirable reputation of producing flour with a very low ash content, good color and high brightness and these traits should be maintained. A small increase in the acceptable limits for “flag” and “poor” when evaluating ash content was passed in 2011.
  + Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis. For CWRW wheat, flour yield also is expressed at a constant ash content of 0.50%,
  + Milling quality measures (starch damage, flour milling yield, flour ash) are objective and levels for candidate cultivars will be assessed against check variety results.
* **Flour Water Absorption:**
  + Due to the longer growth habit and lower wheat protein levels CWRW has a lower water absorption than CWRS. It would be desirable to see an increase to levels approaching CWRS wheat (at an equivalent protein content) but only at a gradual pace so that consistency is maintained within the class.
* **End Product Applications:**
  + CWRW is suitable for hearth and flat breads as well as crackers. It also works well in a blend with CWRS for pan bread flour due to its good mixing and fermentation tolerance.
  + CWRW has been used in steamed breads and is highly regarded for smooth, bright white surfaces and symmetrical shape without the need for flour bleaching.
  + CWRW can also be used for various Asian products including noodles with an important factor being colour retention and appearance of noodle sheets Noodle quality measures (water dough colour, yellow alkaline colour, white salted colour) are objective and levels for candidate cultivars will be assessed against check variety results.
* **Grade Factors:**

Wheat quality can be affected by environmental factors such as weather, disease or insect damage. Their influence is controlled through grading standards established and monitored by the CGC. Grading factors that impact end use performance include:

* + **Sprout Damage** – excess sprouting of grain will result in poor (low) amylograph peak viscosities and low Falling Number levels and can severely impact bread quality. Winter wheat is typically harvested earlier than spring cereals and may avoid late season sprout damage influence. CWRW candidate cultivars should express adequate resistance to sprout damage.
  + **Fusarium** – excess levels of fusarium damaged kernels (FDK) will impact dough strength due to the activity of protein degrading enzymes introduced by the fungus. As well most fusarium species produce toxins, e.g. dioxynivalenol (DON), that are a health and safety concern. CWRW candidate cultivars should express adequate resistance to fusarium damage and in 2014 the first variety rated resistant to fusarium (AC Emerson) will be available commercially.
  + **Midge damage** –Excess levels of midge damage can severely affect bread baking properties. CWRW candidate cultivars should express adequate resistance to midge damage.

**Canada Prairie Spring Red (CPSR) wheat**

CPSR wheat Quality Objectives have evolved over the last three decades. Recent recommendations provide an opportunity for registration of good quality red spring wheat varieties that may not meet the more stringent attributes required for CWRS classification. Compared to CWRS, varieties of CPSR have lower wheat protein content, typically averaging 11.5%. CPSR expresses good milling properties yielding high percentage of clean, bright flour. Flour water absorption tends to be lower than with CWRS varieties. Flexibility in quality attributes allows for consideration of a wider range of grain properties such as kernel hardness which can impact flour milling features including flour ash content, milling yield and starch damage impact on water absorption.

Product applications for CPSR are for lower volume breads (hearth and flat breads), crackers and in blends with stronger wheats for high volume pan bread. Some CPSR varieties possess quality ideal for steamed breads and noodle applications. CPSR varieties registered since 2008 express stronger dough properties and provide good blending opportunity with lower quality wheat from other origins.

Candidate cultivars should express CPSR quality expectations, as follows:

* **Protein Content, Protein Quality**:
  + CPSR is a medium protein milling wheat. Protein content is easily measured at early stages of breeding and candidates should express equal protein levels when compared to check varieties (not including Glenn).
  + CPSR varieties can have a greater loss of protein from wheat to flour when compared to CWRS but this should not be excessive or will be flagged.
  + Current gluten strength targets are acceptable (equal to mean of check varieties) with a desire to maintain dough strength with improved extensibility to compete with stronger US HRW varieties. Check varieties will be chosen to ensure strength is maintained and improved.
* **Milling Quality:**
  + CPSR varieties are generally semi-hard but accommodation of harder varieties will require attention in maintaining good milling and baking attributes without excessive starch damage. Kernel hardness is a selectable genetic trait that can be influenced by the environment.
  + Similar milling principles as explained for CWRS are applicable to CPSR with the same goal of producing bright, clean flour with a wider accommodation in flour ash levels when compared to CWRS.
  + Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis. For CPSR wheat, flour yield also is expressed at a constant ash content of 0.50%,
  + Milling quality measures (starch damage, flour milling yield, flour ash) are objective and levels for candidate cultivars will be assessed against check variety results.
* **Flour Water Absorption:**
  + CPSR varieties tend to have lower flour water absorption.. It is desirable to maintain water absorption levels compared to mean check variety values, not including Glenn, .
  + Flour water absorption is an objective measure and levels for candidate cultivars will be assessed against check variety results.
* **End Product Applications:**
  + CPSR is suitable for hearth and flat breads as well as crackers. It also works well in a blend with CWRS for pan bread flour due to its good mixing and fermentation tolerance.
  + CPSR can also be used for various Asian products including noodles with an important factor being colour retention and appearance of noodle sheets Noodle quality measures (water dough colour, yellow alkaline colour, white salted colour) are objective and levels for candidate cultivars will be assessed against check variety results.
* **Grade Factors:**

Wheat quality can be affected by environmental factors such as weather, disease or insect damage. Their influence is controlled through grading standards established and monitored by the CGC. Grading factors that impact end use performance include:

* + **Sprout Damage** – excess sprouting of grain will result in low Amylograph peak viscosity and low Falling Number levels and can severely impact bread quality. CPSR candidate cultivars should express adequate resistance to sprout damage but there will be wider accommodation in Amylograph peak viscosity values when compared to CWRS.
  + **Fusarium** – excess levels of fusarium damaged kernel (FDK) will impact dough strength due to the activity of protein degrading enzymes introduced by the fungus. As well most fusarium species produce toxins, e.g. deoxynivalenol (DON), that are a health and safety concern. CPSR candidate cultivars should express adequate resistance to fusarium damage.
  + **Midge damage** –Excess levels of midge damage can severely affect bread baking properties. CPSR candidate cultivars should express adequate resistance to midge damage.

**Canada Western Hard White Spring (CWHWS) wheat**

The CWHWS class has been a recent development for wheat producers in Western Canada with the first two varieties registered in 2000. The class target is to provide similar functional properties as CWRS in a hard white spring wheat. Benefits of hard white wheat include better flour milling yield with brighter flour. This provides improved potential for uses in noodle and other Asian product applications. Compared to red wheat with more bitter bran components, hard white wheat provides a sweeter, nuttier flavour in the growing demand for whole wheat flour products.

Protein targets are not as stringent as for CWRS but there is still a desire to provide adequate dough strength (resistance) and dough extensibility with superior mixing tolerance levels.

Candidate cultivars should express CWHWS quality expectations, as follows:

* **Protein Content, Protein Quality:** 
  + CWHWS is a high protein milling wheat with typical commercial protein segregations ranging from 11.5% to 13.5% wheat protein content (measured as N x 5.7 at 13.5% moisture level). Protein content is easily measured at early stages of breeding and candidates should express similar protein levels when compared to check varieties. Lower protein content will be considered if gluten strength parameters are maintained.
  + Gluten strength should be adequate for high volume pan-bread production, especially important in whole wheat and whole grain applications. Gluten strength is a more subjective assessment and is determined through interpretation of various testing methods such as Farinograph, Extensograph or functional bake tests. Gluten strength properties should ideally be linear across the protein range values.
  + CWHWS can be used for a wide range of flour products when used as a single component of a mill grist or when blended with wheat of other classes or origins. Adequate protein level and gluten strength in CWHWS is a key expectation when used for blending.
  + Similar to CWRS, varieties of CWHWS express a low protein loss from wheat to flour, typically about 0.5% loss from wheat (13.5% moisture basis) to flour (14.0% moisture basis). Excess protein loss will be flagged.
* **Milling Quality:**
  + CWHWS is a hard wheat that requires adequate tempering (conditioning) to allow optimum flour extraction. Excessive wheat hardness is not desirable as it can result in roller mills producing elevated flour starch damage that can impact flour water absorption levels in commercial processing. Kernel hardness is a selectable genetic trait that can be influenced by the environment, such as when hard, flinty kernels develop due to excessive heat stress.
  + At optimized commercial mill settings CWHWS achieves a high extraction of bright, clean flour.. The high extraction potential of hard white wheat should still be apparent in small scale test milling where restriction in mill settings may not allow full optimization.
  + Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis. For CWHWS wheat, flour yield also is expressed at a constant ash content of 0.50%,
  + Milling quality measures (starch damage, flour milling yield, flour ash) are objective and levels for candidate cultivars will be assessed against check variety results.
* **Flour Water Absorption:**
  + It is desirable to see improvement in flour water absorption levels for new CWHWS varieties. High flour water absorption in CWHWS is a key expectation when used in blended grists.
  + Flour water absorption is an objective measure and levels for candidate cultivars will be assessed against check variety results.
* **End Product Applications:**
  + High quality CWHWS will meet many processing requirements with a primary application being yeast-fermented, high volume pan-breads whether used alone or in blends. Many dough additives have been developed that assist bakers to achieve dough strength and tolerance parameters but these cannot fully replace fundamental gluten quality.
  + CWHWS can also be used for various Asian products including noodles with an important factor being colour retention and appearance of noodle sheets Noodle quality measures (water dough colour, yellow alkaline colour, white salted colour) are objective and levels for candidate cultivars will be assessed against check variety results.
  + There is some use of CWHWS outside of yeast-raised dough applications such as extruded dough products (pasta, snacks), , crackers and biscuits but there are no specific quality requirements that have been identified for CWHWS to meet in these applications.
* **Grade factors:**

Wheat quality can be affected by environmental factors such as weather, disease or insect damage. Their influence is controlled through grading standards established and monitored by the CGC. Grading factors that impact end use performance include:

* + **Sprout Damage** – excess sprouting of grain will result in low amylograph peak viscosities and low Falling Number levels and can severely affect bread quality. CWHWS candidate cultivars should express adequate resistance to sprout damage.
  + **Fusarium** – excess levels of fusarium damaged kernels (FDK) will impact dough strength due to the activity of protein-degrading enzymes introduced by the fungus. As well most fusarium species produce toxins, e.g. deoxynivalenol (DON), that are a health and safety concern. CWHWS candidate cultivars should express adequate resistance to fusarium damage.
  + **Midge damage** – Excess levels of midge damage can severely affect bread baking properties. CPSR candidate cultivars should express adequate resistance to midge damage.

**Canada Western Soft White Spring (CWSWS) wheat**

CWSWS is a low protein wheat suitable for the production of soft wheat products such as biscuits, cookies, cakes and thickeners. Production of good quality CWSWS is aimed primarily at the domestic market and this wheat can also be used alone or in blends for flat breads and for the production of various types of noodle and steamed bun flours. Growing the crop under irrigation aids in maintaining a low wheat protein content. Due to high agronomic yield and high starch content in CWSWS this wheat has value for industrial ethanol production.

Soft wheat grown in Eastern Canada is aiming for slightly stronger gluten properties to meet requirements in fermented snack cracker applications. Recent discussions within QET membership felt that current weaker gluten properties were more appropriate for soft wheat grown in Western Canada.

Candidate cultivars should express CWSWS quality expectations, as follows:

* **Protein Content, Protein Quality:** 
  + Soft white spring wheat for consumer product applications is characterized by low protein content, typically below 10.5% (measured as N x 5.7 at 13.5% moisture level)
  + Protein content is easily measured at early stages of breeding and candidates should express similar low protein levels when compared to check varieties.
  + Gluten properties should be weak with low mixing resistance accompanied by a reasonably extensible gluten.
  + Gluten strength is a more subjective assessment and is determined through interpretation of various testing methods. For soft wheat the most appropriate strength evaluation is gained through the Farinograph, Alveograph, Solvent Retention Capacity (SRC) and cookie spread test.
* **Milling Quality:**
  + CWSWS is a soft wheat that typically has lower flour extraction levels but should produce flour with a bright, clean appearance.
  + Soft wheat requires shorter tempering (conditioning) times to achieve optimum flour extraction. Excessive wheat softness is not desirable as it can result in lower extraction levels due to increased stickiness and clogging in roller mill and sifter equipment. Kernel hardness is a selectable genetic trait that can be influenced by the environment, such as when hard, flinty kernels develop due to excessive heat stress.
  + Milling quality measures (starch damage, flour milling yield, flour ash) are objective and levels for candidate cultivars will be assessed against check variety results.
* **Grade factors:**

Wheat quality can be affected by environmental factors such as weather, disease or insect damage. Their influence is controlled through grading standards established and monitored by the CGC. Grading factors that impact end use performance include:

* + **Sprout Damage** – excess sprouting of grain will result in poor Amylograph peak viscosities and low Falling Number levels. For some applications it is desirable to have high thickening properties requiring superior Amylograph peak viscosity values. CWSWS candidate cultivars should express adequate resistance to sprout damage.