# PRAIRIE RECOMMENDING COMMITTEE FOR WHEAT, RYE AND TRITICALE

# OPERATING PROCEDURES

Approved: February 2013

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## 1. THE COMMITTEE

### *1.1 Introduction*

This document outlines the evaluation and testing system operated by the Prairie Recommending Committee for Wheat, Rye and Triticale (PRCWRT). The Committee evaluates candidate cultivars of wheat, rye and triticale and, upon the request of the owner or designate, makes recommendations to the Variety Registration Office (VRO), Canadian Food Inspection Agency (CFIA) regarding the suitability of the candidate for registration.

The PRCWRT Operating Procedures have the approval of the CFIA. Any changes to the Committee rules or their appendices require approval by the Committee membership and CFIA. Changes are noted in the Committee minutes, with an updated version of the operating procedures published with the minutes every three years and submitted to the VRO prior to implementation.

### *1.2 Terms of Reference*

The PRCWRT is responsible for testing and evaluation of wheat, rye and triticale candidate cultivars for registration in the agro-ecozones of western Canada.

The PRCWRT has several mandates:

1. To act as a forum for exchange of information relevant to the development of improved cultivars of wheat, rye and triticale for western Canada.
2. To advise regulatory agencies regarding proposed or existing legislation and regulations governing wheat, rye and triticale breeding and cultivar production.
3. To establish guidelines and co-ordinate trials to evaluate the performance of potential cultivars of wheat, rye and triticale.
4. To advise on the performance of lines in registration trials and make recommendations regarding the registration of candidates to the Variety Registration Office, Canadian Food Inspection Agency.

### *1.3 Structure and Membership*

#### 1.3.1 Structure

The PRCWRT consists of three Evaluation Teams that are responsible for the assessment of agronomic performance, disease/pest resistance and end-use quality. The Evaluation Teams are as follows:

- Breeding & Agronomy (AET)
- Disease (DET)
- Quality (QET)

Each Evaluation Team will have a Chair and a Secretary. These individuals will form the Committee Executive. The Chair and Secretary of the PRCWRT will be selected from the Committee Executive.

The Committee Chair and Secretary will normally have terms of three years, which are renewable and commence on April 1. It is encouraged that the Secretary takes the position of Chair following completion of a three-year term. A new Chair or Secretary must be approved by a simple majority vote.

In circumstances where a Chair is unavailable to act in the official capacity of the position, the Secretary will assume the role of Chair. In this case, and where the Secretary is unavailable, the Chair (elected or acting) will appoint a temporary Secretary from among the membership of the Evaluation Team or Committee, whichever is appropriate.

### 1.3.2 Membership

There are two types of membership within the PRCWRT:

1. Full Members (voting privileges)
2. Associate Members (non-voting)

All members are proposed by the Evaluation Teams and are approved by majority vote of the Committee. All members receive data packages associated with the Evaluation Team in which they participate. All members are expected to have an email address to afford timely and inexpensive communication. Individuals who do not qualify for Full or Associate membership but are interested or otherwise involved with the process may attend the meetings as guests, upon the approval of the Chair.

Membership lists for each Evaluation Team with appointed Chairs and Secretaries, as well as for Associate Members, will be updated annually.

#### 1.3.2.1 Full (Voting) Members

Membership consists of individuals actively engaged in the production, development, processing, marketing, regulation and/or evaluation of potential wheat, rye and triticale cultivars for the Canadian prairies and possesses the expertise to do so. Voting members of the three Evaluation Teams fall into one of four industry groups:

1. Individuals engaged in cultivar development or evaluation,
2. Cereal pathologists,
3. Cereal quality specialists,
4. Representatives of industry with expertise in the grain industry such as producers, processors, seed growers, provincial specialists and the like.

To become a voting member, an individual must attend a complete PRCWRT meeting as a guest, decide upon which Evaluation Team to join, be nominated by a current member, and provide a short oral presentation in support of the nomination. On becoming a full member, voting privileges are granted.

New members are considered based on their ability to contribute to the recommendation process rather than the organization they represent. It is expected that members will vote impartially, declare conflicts of interest, and attend the annual meeting regularly. Full members who fail to attend the

PRCWRT Annual Meeting for two consecutive years will be moved to Associate Member status unless an acceptable excuse is provided to the Committee Executive.

There is no membership cap on the number of voting members per Evaluation Team. All full members are allowed a vote at the Evaluation Team level; however, a maximum of 25 members per Evaluation Team will be allowed a vote at Committee deliberations. If the number of Evaluation Team members attending the PRCWRT meetings is greater than 25, each Evaluation Team Chair will call for members to temporarily give up their voting privilege. In the event that there are insufficient volunteers willing to forego their voting privilege, the 25 voters will be determined randomly. A record of the members who have relinquished their vote will be kept so that they will be allowed a vote at the next annual meeting if they wish.

#### 1.3.2.2 Associate (Non-Voting) Members

Associate Members are individuals with a legitimate interest in Committee activities. Examples of Associate Members include but are not restricted to Agriculture and Agri-Food Canada Directors, Canadian Food Inspection Agency Directors, Provincial Government Specialists (e.g.: oilseed specialists), University Administrators or Business Managers whose organizations are active in cultivar production, development or evaluation. Associate Members do not have voting privileges but are allowed a voice during Committee and Evaluation Team meetings and will receive all information packages.

### *1.4 Meetings*

The PRCWRT normally meets annually in late February at a location determined at the previous meeting. Meeting location, room allocation, audio-visual equipment, food and refreshments are organized by the Prairie Grain Development Committee (PGDC) but the PRCWRT is responsible for organizing all other meeting aspects. Extra-ordinary meetings may be called on 30 days notice or less upon the consensus of the membership.

Meetings are open to all interested parties. Non-members must make a request to the PRCWRT Chair to attend the meetings as guest observers. Graduate students will be allowed to attend the meetings without paying the registration fee. The Committee or Evaluation Teams may, by a majority vote, create 'in camera' portions of the meetings as necessary.

Meetings will operate under Robert's Rules of Order.

The normal sequence for the annual February meeting is that Evaluation Teams first meet separately, followed by a meeting of the entire Committee (logistics may result in changes).

### *1.5 Review of Procedures*

The PRCWRT procedures will be reviewed every three years; however, changes may be proposed at any time. Approved amendments will be published in the annual PRCWRT minutes.

## 2. REGISTRATION TRIALS

The conduct of registration trials is the jurisdiction of the PRCWRT. Registration trials are replicated, multi-location agronomic performance tests supplemented with tests for disease/pest response, end-use quality, and/or other important traits as deemed appropriate by the Committee. The purpose of registration trials is to provide data to the Evaluation Teams and the Committee for consideration of candidate cultivars for registration.

Registration trials may be conducted by groups of collaborating institutions or privately. Prior to the commencement of registration testing, each Evaluation Team must approve the procedures used in the conduct of the registration trials; without these endorsements, the registration trial cannot proceed. Where there is disagreement over testing protocols, entry of a candidate into a registration trial, interpretation or validity of data, the majority decision of the Evaluation Team will be final. It is recognised that consultation and discussion between Evaluation Teams may be necessary before a final decision can be achieved.

All common wheat and durum lines that are candidates for an existing wheat class, as defined by the Canadian Grain Commission (CGC), will be tested under the rules for Co-operative Registration Trials (Section 2.1) or Private Registration Trials (Section 2.2). Lines destined for the Canada Western General Purpose (CWGP) class will be tested under the rules outlined in Section 2.3. Fall rye and spring triticale will be tested under the rules outlined in Section 2.4.

Common wheat or durum lines that are not candidates for an existing wheat class may be eligible for contract registration or regular interim registration. Contract registration requires strict identity preservation (Section 4), while interim registration for the purpose of market development usually requires experimental grades under the aegis of the Canadian Grain Commission. Candidates that meet the requirements for testing under Contract Registration rules shall be tested as defined in Section 4. Candidates that do not meet existing end-use quality requirements may be tested for interim registration as prescribed in Sections 2.1 or 2.2, provided that the CGC agrees to establish grades and the proposer or a marketing entity agrees to conduct market development.

Spring rye, winter triticale, and non-standard types of wheat (e.g.: spelt, rivet, dinkel, einkorn, club wheat) may be tested using the rules in Section 2.6 (Method for Introducing New Types of Wheat).

The registration testing procedural framework (Section 2) exists to generate relevant, unbiased, and representative data for candidate cultivars, upon which an informed decision for registration may be based. For new types of wheat, approval of a registration trial protocol does not imply that the infrastructure required to accommodate it will exist. The introduction of new types of wheat into western Canada has many implications for existing wheat classes. It is recommended that institutions developing new types of wheat consult with the Canadian Grain Commission to resolve any marketing challenges that the new wheat type may pose.

Candidates that have the potential to cause biological harm may be rejected for support for registration. Harm is defined as having an adverse effect on human or animal health, and/or adversely affecting the environment. Candidates that introduce production or marketing risks for their own or for other wheat classes or other crops should be noted. The PRCWRT has no legal authority to refuse a recommendation for candidates that have merit and do not cause harm.

### *2.1 Co-operative Registration Trials*

Traditionally, plant breeders, agronomists, plant pathologists, and cereal quality specialists work together to evaluate candidate cultivars in each market class of wheat, as well as winter rye and spring triticale. These collaborative trials are known as "Co-operative Registration Trials", "Co-ops", or "C-Level Tests". The operation of co-op trials is the responsibility of the co-operators in the test, subject to Committee approval. Co-operators in a particular co-op trial are those scientists and field trial managers responsible for conducting the various tests and sponsors submitting candidate cultivars to the registration trial.

The mission of each co-op trial, check cultivars, important agronomic traits and the method of evaluation, disease resistance guidelines, and end-use quality requirements are reviewed each year and described in the appendices. The data collected will be relevant to the test area of the co-op trial. Changes to the rules, check cultivars, traits evaluated, or methodology of evaluation require majority approval by the Committee membership, are recorded in the minutes and are submitted to the Variety Registration Office (VRO) prior to implementation.

The following general principles apply to the Co-operative Registration trials:

a) Locations: Locations are determined by the test co-operators. They may be conducted by the private or public sector and are chosen to represent areas of adaptation for the crop. Growing tests in multiple environments provides the opportunity for assessment of agronomic and end-use quality performance under different growing conditions.
b) Acceptance of entries for testing: As a general principle, six station years of data from the area of its intended commercial production, along with that of appropriate check cultivars, are required for entry into co-operative tests. The test co-ordinator decides the eventual list of entries that are tested, consulting with submitters of entries as required. It is expected that only lines competitive with the checks will be submitted. Plants known to have novel traits (PNT) must have unconfined release status for such material before acceptance into co-operative tests. Plants known to have novel traits that do not have unconfined release can only be tested in Private Registration Trials (Section 2.2). If a failed entry is to be re-entered into a registration trial, permission by the Committee is required.
c) Limits on entry numbers: Every attempt is made to accept all qualified entries. However, resource restrictions require limits to be imposed. The co-operators, subject to approval by the Committee, determine the acceptance of entries.
d) Security of entries: Test co-ordinators and co-operators will take reasonable precautions to ensure the security of test entries.
e) Check varieties: Check varieties are chosen by the Committee to represent specific classes, types and adaptation. Check varieties are normally the best commercially available cultivars for each class or type. In some instances checks are chosen to provide a basis of comparison for quality or disease evaluation. Candidate cultivars will be compared to the appropriate check(s) of the class for which they are being considered. Note that this may not be the same check as the one used when the line was entered into the registration trial. The candidate will not be compared to other lines in the test for registration recommending purposes. When interpreting results, a candidate will not be compared to a check variety for a specific trait when the check is known to perform poorly for that trait.
f) Disposition of entries: The owner of a line can withdraw it at any time. Lines are retained in the registration trials based on the request of the owner and the approval of the co-operators and

the Committee. A line will only be kept in trials for a year beyond the minimum testing requirement upon agreement of the Committee.

g) Fees: The PRCWRT may establish a fee structure and a mechanism for handling the fees to ensure that they are applied to the costs of operating the tests. Such fees are subject to annual review. Contact the test co-ordinator for details.
h) Condition of acceptance: It shall be a condition of acceptance of a candidate cultivar for testing, that the party submitting the candidate cultivar agrees that the testing and evaluation procedures used by the PRCWRT are appropriate and that these testing and evaluation procedures, however defined, shall not justify an appeal of a Committee decision.
i) Limitation of liability: It is a condition of acceptance of a candidate cultivar for testing that the party submitting the candidate cultivar acknowledges that neither the PRCWRT nor its members and agents shall in any way be liable for any error or omission occurring as a result of the testing and evaluation process.
j) Ethical conduct: Co-operative Registration Trials are subject to the provisions of the Canadian Wheat Workers' Code of Ethics as defined and periodically updated by the Canadian Wheat Improvement Network (CWIN).

### 2.1.1 Role of the Co-ordinator

Co-op trials are managed on behalf of the Committee by a test co-ordinator and the co-operating group. It is the collective responsibility of the participants in the co-op trial to ensure unbiased and accurate testing of the candidates. A current list of co-ordinators can be obtained from the PRCWRT Secretary.

Test co-ordinators are appointed by the co-operators in the test, subject to approval by the Committee. Co-ordinators are responsible, in consultation with the co-operators, for deciding on admission of new candidates, general co-ordination of the trial, for compiling and analysing the data, and for preparation and distribution of the annual report. Annual reports of the Registration Trials must be available to the PRCWRT membership at least seven days prior to the February annual meeting, where the tests and the disposition of entries are reviewed. Co-ordinators are reminded that participants in the Registration Trial will require the reports in advance of general availability so that *Requests for Support of Registration* can be prepared. Revised reports are included in the Committee minutes and are circulated to the membership following the meeting.

### 2.1.2 Entry and Retention of Candidates

Candidate cultivars in a co-op trial will have sufficient merit to warrant registration testing and the consumption of limited research resources. Lines are admitted or retained by consensus among the co-operators based on the performance of the candidates relative to the check cultivars and the likelihood of their ultimate registration. Numbers of entries in the co-op will be kept low enough to ensure precision and avoid undue demands on those performing the testing. Candidates accepted for testing under Contract Registration Procedures (Section 4) will not normally be tested in co-op trials.

Entry of candidates into a co-op trial typically requires six station-years of acceptable yield data from the targeted agro-ecological zone, plus satisfactory evaluations for important agronomic, disease and end-use quality traits. To control the number of qualified candidates in a co-op trial, entry requirements may be temporarily waived or increased by consensus of the co-operating group. There is no guarantee that all lines proposed for co-op testing will be admitted. Where there is serious concern that the requirements for testing a particular candidate(s) would seriously jeopardize the normal operation of the co-op trial, the co-operating group may refuse entry to the registration trial.

Seed stocks for candidate cultivars used in the registration trials must be of reasonable purity. As a guideline, the standards for germination should be similar to that required for Certified Seed, as defined by the *Seeds Regulations, Part I.*

As candidate cultivars have not been through the rigors of breeder seed development, morphological off-types may be expected, but should not exceed five percent. Acceptable off-types are those plants that exhibit phenotypes or genotypes that can be reliably removed during the process of breeder seed development; for example, seed colour, plant height, rust reaction. A line that has a trait that is difficult to reliably select against during breeder seed development will not be acceptable. The testing conditions, number of plants in yield plots (typically about 1000), and proximity to other cultivars precludes reliable detection of variants.

Retention of candidates for second and third years of testing should focus on performance in the co-op trial. Justification for retention will be required for lines that have been rejected by any of the Evaluation Teams. Candidates will not be tested beyond the three years required for registration unless there is agreement among the co-operating group to do so. In some cases, candidates retained for a second or third year of testing in one co-op trial may "cross-over" to another co-op trial if a suitable case is made (e.g.: Western Bread Wheat co-op to Central Bread Wheat co-op).

Candidate cultivars that fail to meet end-use quality specifications of the intended wheat quality class following a year of registration testing will not be re-entered into the same registration trial without agreement by the appropriate Evaluation Team Chair.

In the event of an unresolved conflict within a co-operating group, the decision of the Committee will be final.

### 2.1.3 Trial Operation

Co-operators should meet all reasonable requirements set by the test co-ordinator with regard to quality, quantity, and time for submission of seed, provision of data for consideration of candidates, and attendance at meetings to determine the disposition of candidates. Failure to meet these requirements may result in deletion of the candidate from the co-op trial. While the co-ordinator may arrange for increase of the candidates under test, roguing and monitoring of seed purity is the responsibility of the sponsor of the candidate.

Although co-op trials may be run without charge, co-operators are reminded that testing candidate cultivars is expensive. The Committee has the authority to institute a system of charges if the costs and benefits of operating the co-op trials become unbalanced. Institutions that do not make a substantial contribution towards the co-op testing system may be charged a candidate entrance fee to help defray the costs of testing. An offer of payment for testing does not assure entry or retention of a candidate in the co-op trial. A description of any such charges will be documented in the appendices as a requirement for entry.

### 2.1.4 Experimental Design and Traits Measured

Testing of individual lines shall normally encompass three consecutive years. Agronomic trials shall be conducted across a broad range of climate and soil types at an approved set of sites in the area of expected commercial production. An average of eight sites of acceptable yield data per year is required.

One site per year may be altered from the approved list without prior consultation. Individual registration trials shall be no larger than 36 entries, with a minimum of three complete replicates. Use of recognized experimental designs that permit localized error control through the use of sub-blocks is encouraged.

The traits to be measured for the various wheat classes are summarized in Appendices C, D, and F.

### 2.1.5 Acceptability of Data

In general, yield data will be considered acceptable if the coefficient of variation (CV) is less than 12 percent. Yield data may be acceptable if the CV is in the range of 12 to 15 percent and the appropriate F-test for genotypes is significant ($p<0.05$), or in the range of 15 to 20 percent if the appropriate F-test for genotypes is highly significant ($p<0.01$).

### 2.1.6 Loss of Data

The loss of data from natural causes (e.g.: drought, flooding, hail, winterkill) is often unavoidable; however, loss of data due to pre-existing conditions (e.g.: soil variability, salinity, weed problems) should be minimized. Where there is a shortfall of greater than three station-years from the requirement of 24 broadly distributed station-years of acceptable data over three years, justification and Committee approval is required.

### 2.1.7 Check Cultivars

Check cultivars will include widely grown, established cultivars, special purpose cultivars (e.g.: solid stem cultivars resistant to wheat stem sawfly) or recent cultivars of superior merit. Changes in check cultivars must be approved by the Committee and are listed in the annual Committee minutes. Data collected for a check cultivar prior to its registration are considered to be check data.

A superior cultivar with an offsetting weakness in a particular trait (e.g.: a high yielding cultivar with unusual susceptibility to bunt) may be included as a check without diminishing the selection standard for the trait in which it is deficient. Such cultivars will be specifically excluded as a check for the traits in which they are deficient at the time of their elevation to check status and all such exceptions are to be noted in the list of checks.

Seed stocks for check cultivars used in the registration trials must be of reasonable purity. As a guideline, the standards for purity and germination should be similar to that required for Certified Seed, as defined by the *Seeds Regulations, Part I*.

### 2.1.8 Trial Reporting

Data for each agronomic trait must be summarized on a site basis, with standard errors or least significant differences (LSD) reported for each data type, if possible. The summary report must include information on test supervisors, site conditions, planting date, plot size, fertilizer and pesticide use, and area harvested.

Annual reports of the Registration Trials will be made available to the PRCWRT membership at least seven days prior to the February annual meeting. A draft report may be circulated in advance. In

practice, the end-use quality evaluation reports will be made available as soon as possible before the meetings.

If errors in the reports are detected by the Evaluation Teams or the Committee, revised reports will be made available to the Chair and Secretary for inclusion in the final Committee Report.

#### 2.1.9 New Co-op Trials

Upon agreement of the Committee, new co-operative registration trials may be established. Operation and standards for new trials will be similar to existing co-op registration trials.

#### 2.1.10 Changes in Evaluation Team Guidelines

Review of Evaluation Team guidelines should be voted on by the entire Committee and implemented on an established time frame. Changes are recorded in the minutes and are submitted to the Variety Registration Office (VRO) prior to implementation.

#### 2.1.11 Canadian Wheat Workers Code of Ethics

All public Co-operative Registration Trials adhere to the principles outlined in the Canadian Wheat Workers' Code of Ethics (Appendix H). A copy of the code should be included in each Registration Trial report. Private Registration Trials should be used in situations where there is a desire to prevent or restrict use of a candidate cultivar beyond that allowed in the code.

#### 2.1.12 Pre-Registration Trials

Data for entry of candidates into co-op trials may be obtained by organizing or participating in co-operative pre-registration trials (e.g.: "A" and "B" level tests). While the consideration of these trials may appear as an agenda item, pre-registration trials are not run under the auspices of the Committee. The co-operating groups for these trials set the rules for their operation and the Committee will not mediate disputes arising from their conduct.

### *2.2 Private Registration Trials*

Registration testing may be conducted outside of the co-op system; while registration testing is required for cultivar registration, co-operative testing is not. Private Registration Trials must emulate the professional standards set by comparable Co-operative Registration Trials. The company or institution conducting a Private Registration Trial must obtain approval of the testing protocols from each Evaluation Team prior to candidate evaluation, rather than when a recommendation for support of registration is being sought. Review of all protocols prior to testing will ensure the use of appropriate experimental designs and check cultivars that will facilitate assessment of the candidates by the Evaluation Teams and the Committee. Without prior approval of the testing protocols by each Evaluation Team, the Committee will not recognize the proposed Private Registration Trial. Plants with novel traits that do not have unconfined release can only be tested in Private Registration Trials.

The following are rules that are in addition to those specified in section 2.1 and apply to the establishment and conduct of Private Registration Trials for candidate cultivars intended for the market classes of wheat (as defined by the Canadian Grain Commission), winter rye and spring triticale. Note

that, particularly with respect to disease/pest resistance and end-use quality testing, it is very important to consult with the pertinent Evaluation Teams to determine the specific testing requirements and/or methodology prior to seeking approval of the proposed testing protocols.

### 2.2.1 Request for Private Registration Trial

The proposal for a Private Registration Trial will be submitted to the Committee no later than February 1 in the year of first planting, to allow discussion prior to the annual meeting, where approval of the trial will be requested. The class of wheat for which the experimental lines are candidates shall be identified at the outset. It is suggested that the Evaluation Team Chairs be notified of the intent to request a private registration trial prior to the February 1 deadline to expedite discussion and authorization by the Committee.

### 2.2.2 Independent Test Data

At least eight of the minimum of 24 station-years of acceptable yield data must be provided from an individual or organization that is independent from the candidate proposer, with a minimum of two sites of independent data for each calendar year tested. Identification of the independent source of data is compulsory. The requirements for independent test data may be waived upon approval of the Committee.

### 2.2.3 Agronomic Data Requirements

With the exception of grain yield, data for agronomic traits normally collected for a comparable Co-operative Registration Trial (see Appendix C) is required from at least three sites per year.

### 2.2.4 Disease Resistance Data

As a minimum, resistance to stem rust, leaf rust, common bunt and Fusarium head blight must be assessed in a manner acceptable to the Disease Evaluation Team, using a mixture of races carrying all commonly occurring virulences. It is recommended that seedling reactions to common races of stem and leaf rust be determined, and resistance to loose smut be assessed based on inoculated field or greenhouse nurseries using approved protocols. Disease Resistance Guidelines are published in Appendix D.

### 2.2.5 End-use Quality Testing

Requirements for end-use quality evaluation vary depending on the class of wheat for which the candidate is intended (Appendix F). It is suggested that the Grain Research Laboratory, Canadian Grain Commission (CGC) be consulted for testing requirements and methodology before approaching the Quality Evaluation Team for approval of the quality testing protocol. As of 2008, characterization of candidates for Kernel Visual Distinguishability is no longer required.

### 2.2.6 Service Fees

Private Registration Trials may have access to the disease and quality testing services used by the Co-operative Registration Trials under a fee for service arrangement, if resources permit. All arrangements must be finalized before the proposal for the Private Registration Trial is submitted to the Committee.

#### 2.2.7 Trial Reporting

Annual reports of the Private Registration Trial will be made available to the Committee membership at least seven days prior to the February annual meeting. The Evaluation Teams and Committee will conduct a yearly vote to accept the report data as valid, and will provide guidance to improve the tests and/or report, if necessary. Revised reports will be made available to the Chair and Secretary for inclusion in the Committee Report.

The report should be prepared in a manner similar to that used for co-operative registration trials. Data for each agronomic trait must be summarized on a site basis, with standard errors or least significant differences (LSD) reported for each data type if possible. A brief explanation of the testing protocol for each trait measured is required to assist the Evaluation Teams and Committee in determining the validity of the data. The summary report must include information on test supervisors, site conditions, planting date, plot size, fertilizer and pesticide use, and area harvested.

### *2.3 Canada Western General Purpose Wheat*

#### 2.3.1 Data Requirements

A minimum of fifteen station-years of agronomic data collected over a period of three or more years, with at least two locations per province per year in at least two provinces, is required. Data must be collected from the area of adaptation and intended production. Use of pre-registration test data may be used to meet the minimum requirement for 15 station-years of agronomic data, provided that it is of sufficient quality. At least one-third of the fifteen station-years of data must be provided by an individual or organization that is independent of the individual and organization proposing the candidate cultivar, with a minimum of one site of independent data for each calendar year tested. Identification of the independent source of data is compulsory. Three years of disease resistance data are required and may consist of one year of pre-registration data and two years of registration test data. If it is deemed that there is insufficient disease resistance data to provide a recommendation, a third year of registration testing may be requested by the Disease Evaluation Team. The collection of additional disease resistance data does not necessitate additional agronomic testing.

#### 2.3.2 Traits Measured

Please refer to Appendix C and Appendix D for the list of traits that must be measured, relative to appropriate check cultivars.

#### 2.3.3 Trial Reporting

Trial reporting for Canada Western General Purpose wheat is the same as that outlined in section 2.1.9.

### *2.4 Fall Rye and Spring Triticale*

#### 2.4.1 Data Requirements

A minimum of 15 station-years of agronomic data collected over a period of three or more years is required. Data must be collected from the area of adaptation and intended production. At least one-

third of the fifteen station-years of data must be provided by an individual or organization that is independent of the individual and organization proposing the candidate cultivar, with a minimum of one site of independent data for each calendar year tested. Identification of the independent source of data is compulsory. Disease resistance data is required for at least two of the years of testing.

#### 2.4.2 Traits Measured

Please refer to Appendix C and Appendix D for the list of traits that must be measured, relative to appropriate check cultivars. If the candidate is intended as an animal feed or forage crop, inclusion of data indicating its suitability for the proposed purpose is appropriate and encouraged.

#### 2.4.3 Trial Reporting

Trial reporting for fall rye and spring triticale is the same as that outlined in section 2.1.9.

### *2.5 Validation of Registration Trials*

#### 2.5.1 Site Inspection

It is the duty of the registration trial manager (co-op co-ordinator or private registration trial supervisor) to ensure that a recognized plant breeder who is independent of the test site or registration trial inspects at least one-third of the sites each year. For example, inspection of trials by co-op co-ordinators for test sites grown by participating co-operators qualifies as an independent inspection. Further, inspection of a co-op trial by a plant breeder employed at the same location is permissible if there is no association with the trial. Access to registration trials will be granted to the test co-ordinator, co-operators, and other parties with a bona fide interest in the test. Site co-operators should be contacted in advance to provide entrance to the site, treatment lists, randomizations, and other pertinent information.

Inspectors should discuss concerns for the site with the individual responsible and, if possible, agree on corrective action. A brief, critical evaluation of the site should be written, identifying the areas that required attention and the solutions discussed. These reports shall be forwarded to the co-op co-ordinator (Co-operative Registration Trials) or Committee Chair (Private Registration Trials) for follow-up and additional inspection if necessary. If the issues are not resolved to the satisfaction of the co-op co-ordinator (Co-operative Registration Trials) or the Committee Chair or designate (Private Registration Trials), the concerns will be forwarded to the Committee Executive (Chairs and Secretaries of the Evaluation Teams).

#### 2.5.2 Data Validation

Data for each agronomic trait must be summarized on a site basis, with standard errors or least significant differences (LSD) reported for each data type if possible.

Test co-ordinators must use discretion in judging acceptability of grain yield data for each site. In general, yield data will be considered acceptable if the coefficient of variation (CV) is less than 12 percent. Yield data may be acceptable if the CV is in the range of 12 to 15 percent and the appropriate F-test for genotypes is significant ($p<0.05$), or in the range of 15 to 20 percent if the appropriate F-test for genotypes is highly significant ($p<0.01$).

## *2.6 Method for Introducing New Types of Wheat*

New types of wheat that are ineligible for existing wheat classes require special planning, particularly as it relates to quality testing prior to potential introduction into registration trials. Quality testing to assess potential in existing or new markets must be performed in consultation with the Canadian Grain Commission and a grain marketing entity prior to entry into an existing or new registration trial. The CGC, candidate proposer, and the marketing entity can determine jointly how the new wheat type should be produced for early quality and market testing purposes, and how all related costs are shared (including approaching other parties for funding and/or in-kind support).

Following early market testing, if the the developer wishes to proceed toward registration, a proposal for registration testing must be submitted to PRCWRT for approval. This proposal should be accompanied by comments from the CGC and marketing entity with respect to the market potential of this wheat type, agronomic and disease evaluation information, and initial plans for eventual handling and segregation of the wheat type, if registered.

Registration testing of spring rye, winter triticale, and non-standard types of wheat (e.g.: spelt, rivet, dinkel, einkorn, club wheat) will proceed as outlined in Section 2.2 (Private Registration Trials), with the data requirements, traits measured, and trial reporting as outlined below.

Discussions with the Evaluation Teams are also appropriate to develop a testing regime. Negotiation of responsibilities and costs for obtaining the required data should also occur.

### 2.6.1 Data Requirements

A minimum of 12 station-years of agronomic data collected over a period of three or more years is required. Data must be collected from the area of adaptation and intended production. At least one-third of the twelve station-years of data must be provided by an individual or organization that is independent from the candidate sponsor, with a minimum of one site of independent data for each calendar year tested. Identification of the independent source of data is compulsory. Disease resistance data is required for at least two of the years of testing.

### 2.6.2 Traits Measured

The following traits must be measured relative to appropriate check cultivar(s): grain yield, maturity, height, lodging, kernel weight, test weight and relevant disease resistance characteristics. For fall-seeded crops, winter survival must be reported. If the candidate is intended as an animal feed or forage crop, inclusion of data indicating its suitability for the proposed purpose is appropriate and encouraged.

### 2.6.3 Trial Reporting

An annual summary report of the test data is required. Evaluation Teams are requested to conduct an annual vote to accept the data as valid and/or provide guidance to improve the tests. An annual report must be prepared in a manner similar to that used for other Registration Trials and circulated to the Committee at least seven days prior to the February annual meeting.

When a candidate is proposed for registration, a complete summary report should be prepared in a manner similar to that used for the Registration Trial reports. Data for each agronomic trait must be

summarized on a site basis, with standard errors or least significant differences (LSD) reported for each data type, if possible. A brief explanation of the testing protocol for each trait measured is required to assist the Evaluation Teams and Committee in determining the validity of the data. The summary report must include information on the test co-operators, site conditions, planting date, fertilizer, and pesticide use. Before the candidate is considered for registration, a vote to accept the summary report data as valid will be conducted by each Evaluation Team and the Committee. If an Evaluation Team rejects a data set, the reason(s) that the data cannot be considered valid or reliable must be presented to the Committee prior to final deliberation on the candidate.

The *Request for Support of Registration* must be based on the summary report and prepared in the standard manner described in Sections 3.1 to 3.4. The complete summary report must accompany the *Request for Support of Registration*.

## 3. THE REGISTRATION PROCESS

### *3.1 Recommendation for Registration*

Before a candidate cultivar can be registered, it must have a recommendation from a recognized Recommending Committee, such as the PRCWRT. Recommendations to "support" or "object to" a candidate cultivar are made on the basis of information provided to the Committee via the registration trials and evaluation by the Evaluation Teams.

The sponsor will provide a *Request for Support of Registration* and written summary to the Committee members no later than the Monday, one week prior to the start of annual PRCWRT meeting.

Except in very unusual circumstances, the Committee will only consider a *Request for Support of Registration* for candidates that have shown satisfactory performance in three years of registration testing. Without strong evidence of urgent, general benefit to the industry, candidates will not be considered for full registration based on less than three years of registration data. If a candidate has been tested in registration trials for three years, but data are absent for a trait or set of traits through no fault of the sponsor, consideration of the candidate may proceed using the data that are available.

Interim registration may be requested following two years of registration testing if for market development purposes. This requires agreement by the Canadian Grain Commission and suspension of normal Committee procedure.

Interim registration may be requested following one year of registration testing if there is a demonstrated urgency and general benefit to the industry. Urgencies may revolve around health and safety. For an interim registration based on one year of registration testing to be successful, agreement from the Canadian Grain Commission must be obtained, suspension of normal Committee operating procedures is required, and the motion for support of the candidate must pass by a two-thirds majority vote.

Note that all proposed motions to suspend normal Committee operating procedures require a two-thirds majority vote to pass.

Interim registration may be granted for up to a total of five years, with a maximum three-year initial recommendation.

Recommendations to support the registration of a candidate cultivar are in effect for two years. The variety registration request must be submitted to the CFIA VRO within the two-year period from the date of the recommendation vote. Upon the discretion of the Chair, the *Recommendation for Registration* may be extended for an additional six months to allow completion of the registration documents (to August 31). If the request document is not received by the VRO within this timeframe, the Committee is required to review the original request document and revote on the candidate.

Recommendation for registration does not represent a recommendation to farmers.

Recommendation for registration does not include information on distinguishability of the candidate cultivar from other currently registered cultivars. It is the responsibility of the cultivar sponsor to provide this information.

## *3.2 The Request Document*

The *Request for Support of Registration* will be concise and error free. Legible copies of the request document must be available to the voting membership of the Committee no later than the Monday, one week prior to the start of the annual PRCWRT meeting. By majority vote, the Committee may refuse to consider a request on the grounds of late circulation, illegibility, or inaccuracy.

A *Request for Support of Registration* should be made no later than two years after publication of registration data as provided by the three Evaluation Teams.

### 3.2.1 Description of the Candidate

The first page will contain the following information: the proposer and owner of the candidate, the grain class for which the line is a candidate, the registration category being sought (interim or full), a brief description of the phenotype, testing history, all designations under which the candidate has been tested, all strengths and weaknesses of the candidate, the expected area of adaptation, expected end-use, and the rationale for registration. Details of parentage, derivation and selection history must be included with the phenotypic description, but exceptions may be made if they disclose information of significant technological or commercial value. Where these details are omitted, justification may be required.

### 3.2.2 Data Summaries

Second and subsequent pages will concisely summarize the agronomic performance and disease/pest resistance. A summary of available end-use quality should also be included; however, the Quality Evaluation Team will usually consider available quality information *in extenso*. Summaries should be based on all registration trials in which the candidate was tested, using the data as analyzed and reported in the registration trial reports. It is suggested that data be organized by trait to simplify comparisons between years.

A candidate proposed for registration will be compared to the designated check cultivars in the registration trial(s) in which it was evaluated. The check cultivars are those that are so designated at the time the *Request for Support* is made. Data collected for a check prior to its registration is considered to be check data. Performance of other candidates unregistered at the time of application is not relevant, nor is the performance of previously registered cultivars not designated as checks.

The manner in which data were summarised will be obvious, in accordance with accepted scientific practice and will not conceal any weakness of the candidate. Registration trial data may be reanalysed, and other supporting data may be introduced in support of specific or unusual claims of performance; however, this will not replace the registration trial summary. The Committee may assume that a candidate is deficient in an important trait if it is excluded from the summary.

### 3.2.3 Definition of Merit

To receive support for registration, a candidate will show merit. A candidate that shows merit is *"equal to"*, *"better than"* or *"superior to"* current check cultivars. The phrase *"equal to"* is defined as arithmetic equality to the mean of the checks. The phrase *"better than"* is defined as arithmetic superiority to the check mean but lacking statistical significance. The phrase *"superior to"* is defined as statistical superiority to the check mean by a two-tailed test at the 5% level using the pooled error mean square as

error. A candidate that shows a deficiency is "*less than*" or "*poorer than*" the current check cultivars. The phrase "*less than*" is defined as arithmetic inferiority to the check mean but lacking statistical significance. The phrase "poorer *than*" is defined as statistical inferiority to the check mean by a two-tailed test at the 5% level using the pooled error mean square as error.

In practice, few candidates reach the minimum standard in all of the important characteristics under consideration. Most will show a collection of strengths and weaknesses in relation to the checks.

#### 3.2.4 Regulatory Requirements

Statements indicating the expert opinion of the Quality Evaluation Team will be made each year of candidate evaluation and recorded in the minutes. Usually, the quality of a candidate must be judged equal to the relevant checks in each year of testing to be considered satisfactory for registration.

#### 3.2.5 Supplementary Data

Data collected external to the registration trials may be included in the *Request for Support of Registration* to improve the case for registration or substantiate claims of specific or unusual performance. External data from the prairie region of Canada or other relevant source will be considered a supplement to the registration trial data, not a substitute for it. Registration trial data and supplementary data must be presented in separate tables and labelled appropriately. A motion to accept the supplementary data as part of the *Request for Support of Registration* must be passed by a two-thirds majority in both the Evaluation Team and Committee. Only data that have been passed by the Committee can be considered and discussed by the Committee.

### *3.3 Conduct of Evaluation Teams and the Committee*

#### 3.3.1 Role of the Evaluation Team

Each Evaluation Team will consider the merit of candidate cultivars proposed for registration prior to the Committee meeting. The Evaluation Team Secretaries will provide their respective team recommendations and basis for them arising from this evaluation in writing to the Committee at the time of candidate deliberations.

It is recognized that in the case of the Disease and Quality Evaluation Teams, only those specific traits are considered but the Breeding and Agronomy Evaluation Team will discuss disease reaction and quality parameters, as they constitute part of "breeding package". The interpretations made on disease and quality characteristics at the Breeding and Agronomy Evaluation Team meeting are subject to formal interpretation and reporting by the Disease and Quality Evaluation Teams.

#### 3.3.2 Role of the Committee

The purpose of the Committee is to provide a recommendation to "support" or "object to" the registration of a candidate cultivar, based on information provided by the registration trials and interpretation of the data by the Evaluation Teams.

It is the responsibility of the Committee Secretary to inform the Registrar, Variety Registration Office, Canadian Food Inspection Agency, in writing of the decision of the Committee with copies to the

sponsor, and Committee Chair. Copies of the *Request for Support of Registration* and the statements from the Evaluation Teams will also be provided to the sponsor and to the Variety Registration Office.

### 3.3.3 Voting Procedures

Voting is valid only when a quorum is present. The quorum for Evaluation Team meetings shall be fifty percent of the voting members. For the Committee, a quorum will be determined as 50% of the number of registered members and 50% of each of the attending Evaluation Team members at the beginning of the Committee meeting. For other Committee business, a minimum quorum of 35% of registered voting members is required. It is expected that all members will vote impartially.

Evaluation Team votes are normally conducted by a show of hands.

At the Committee level, voting is by paper ballot for variety recommendations. All other motions entertained by the Committee will normally be voted on by a show of special voting ballets that are distributed to voting members at the beginning of the meeting.

The Chair is allowed to actively participate in the discussions and is entitled to vote. A simple majority will constitute a positive recommendation. In the event of a tie, a re-vote will be conducted in which the Chair will not cast a vote.

The proposer of a candidate cultivar who is a full member of the Committee may vote on the candidate.

In extra-ordinary circumstances and at the discretion of the pertinent Chair, votes may be conducted using regular mail, facsimile or electronic mail. The quorum for this type of vote shall be a response from fifty percent of the voting members.

Where the number of abstentions is equal to or greater than one-third of the votes cast, the Chair will ask for a re-vote. If the re-vote results in the number of abstentions being equal to or greater than one-third of the votes cast, the Chair will file a report stating that no recommendation could be made.

Any changes to voting procedures by an Evaluation Team or the Committee must be approved by the Committee in advance of the next meeting.

#### 3.3.3.1 Evaluation Team Votes

At Evaluation Team deliberations, the attributes of the candidate cultivars will be considered on the basis of individual disciplines (Breeding & Agronomy, Disease, Quality). It is recognized that in the case of the Disease and Quality Evaluation Teams, only those specific traits are considered but the Breeding and Agronomy Evaluation Team will discuss disease reaction and quality parameters, as they constitute part of the “breeding” package.

The Evaluation Team Chair will call for a vote of those in favour of each of the following categories:

- Support: the candidate’s total attributes for the traits being considered are an improvement over those of the check cultivar(s) and/or an improvement over those specified in agreed-to performance guidelines.
- Do Not Object: the candidate’s attributes for the traits being considered are similar to those of the check cultivar(s).

- Object: the candidate's attributes for the traits being considered are inferior to those of the check cultivar(s).
- Abstain: abstentions are only expected in the case of an evident conflict of interest or in the absence of information on which to base a decision.

All full (voting) members are allowed a vote at the Evaluation Team level. Voting on candidates within each Evaluation Team differs:

The Breeding and Agronomy Evaluation Team only votes on third-year entries for which a *Request for Support for Registration* has been submitted. Advancement of first and second-year entries is decided through negotiation between the pertinent test co-ordinator and those submitting lines into a trial.

The Disease Evaluation Team votes on each third-year entry based on an agreed set of guidelines for each disease. First and second-year entries are reviewed and categorized as having an adequate disease package and worthy of advancement or not. These groups are then voted upon.

The Quality Evaluation Team votes once on the end-use quality of each line for each year of evaluation. This vote includes third-year candidates in which a recommendation for registration is being considered.

#### 3.3.3.2 Committee Votes

At the Committee level, all members will consider the overall attributes of the candidate (the balance of agronomic, disease and end-use quality traits) based on information provided by the registration trials and interpretation of the data by the Evaluation Teams. Deficiencies in one characteristic may be compensated for by strength in another, e.g.: lower yield for earlier maturity, lower yield for higher quality.

The Chair or Secretary of each Evaluation Team will present their team reports orally. A motion to support the registration of the candidate cultivar follows. If necessary, upon the discretion of the Committee Chair, the case for support is then presented by the breeder or designate. This should only be necessary if one or more of the Evaluation Teams have raised concerns about attributes of the candidate cultivar. Following discussion, all members will cast a vote. Written reports are provided from each Evaluation Team to the Committee Secretary.

Votes are cast in three categories (Support, Object, Abstain) based on the data supplied. A maximum number of 25 voting members per Evaluation Team will be allowed a ballot. Members are reminded that at Committee deliberations, abstentions are only expected in the case of an evident conflict of interest or in the absence of information on which to base a decision.

Voting will be conducted by a paper ballot. Votes will be counted by three PRCWRT Associate Members but not by any of the PRCWRT Executive. The counts will be audited after the meeting. The auditor will not be a member of the PRCWRT but must be agreed upon by the membership. Any variance between the initial vote counts and the auditor's review of the ballots will be communicated to the membership upon receipt of the vote auditor's report. The voting ballots will be kept for two years.

If the *Request for Support of Registration* or trial reports have missing or erroneous data or omission of pertinent data is used as a basis of a decision, the sponsor may call for a re-vote on the revised data package. This request must be in writing with an explanation and a new supporting document. The PRCWRT Executive will determine if there was an omission or error and if this information could have

changed the original decision. If so, the Committee will be informed and a re-vote will be conducted. If the annual meeting has concluded, voting will be conducted by regular mail, facsimile or electronic mail.

Disagreements on procedural interpretation will be raised at the Committee meeting and settled by majority vote.

### *3.4 Appeal of Committee Recommendation*

The PRCWRT recommendation to object to the registration of a candidate cultivar may be appealed by the sponsor of the candidate. The grounds for an appeal will centre on arguments that the Committee did not follow prescribed procedures or the recommendation was the result of erroneous data. The criteria used in making the recommendation shall not be subject to appeal, as these criteria have been discussed and ratified by the Committee and form the basis of merit evaluation in the registration trial. A sponsor wishing to contest the decision of the Committee must submit a written application to the Chair no later than March 31. The application must indicate the complete basis of the appeal and include a copy of the data package prepared for the candidate in question. The PRCWRT Chair will convene an Appeal Board and notify the appellant and the Variety Registration Office of the decision by April 30.

The Appeal Board will consist of 5 to 7 regular Committee members. The number, composition and members of the Appeal Board will be determined by the PRCWRT Chair, who will inform the appellant of the composition of the Appeal Board, prior to hearing the appeal. The appellant may propose up to two alternative Appeal Board members, with acceptance of the alternates upon the discretion of the Chair. It is recommended that the Appeal Board be an odd number to avoid a tie vote. Each Evaluation Team must be represented by at least one member. If the appeal is centred upon the actions of a particular Evaluation Team, more than one member of that Evaluation Team should be represented. The PRCWRT Chair will preside over the proceedings of the appeal, but will not vote. The appellant or a designate has the right to attend the appeal proceedings to present the case for the appeal, but does not have a vote. Following the hearing of arguments and any clarifications required by the Appeal Board, a secret ballot will be conducted and scrutinized by the Chair.

The Appeal may take one of several forms as decided by the appellant.

- A written case which is voted upon by the Appeal Board using regular mail, facsimile or electronic mail.
- A conference call where the Appellant presents arguments based on documentation previously distributed to the Appeal Board.
- A meeting where the Appellant presents arguments based on documentation previously distributed to the Appeal Board.

All Appeal Board travel and meeting expenses will be paid by the appellant. No additional appeals will be available at the Recommending Committee level.

### *3.5 Use of Discretion*

It is critical that the Evaluation Teams and the Committee use good judgement when dealing with their Operating Procedures. Under extenuating circumstances, it may be necessary to temporarily disregard

approved procedures. This should not be a common occurrence. The Committee should proceed carefully when deviating from its Operating Procedures. A successful motion to suspend regular procedures requires justification and a minimum two-thirds majority vote.

The Committee may suspend a particular guideline to allow consideration of a candidate by a two-thirds majority vote. The rationale for such action and the record of the empowering vote will form part of the recorded decision. The Variety Registration Office must be notified of any candidate cultivar supported where regular guidelines have not been adhered to and the reasons for the special consideration.

Situations that would be appropriate for setting aside the rules may include the following:

- Inadequate data collection due to weather related damage, despite due diligence in executing trials to generate the required quantity and quality of registration data.
- To provide the opportunity to consider interim registration.

### 3.6 Application for Registration

Applications for registration of the recommended candidate should be submitted on the *Variety Registration Application Form* available from the Variety Registration Office, or from the Canadian Food Inspection Agency's website (www.inspection.gc.ca). The application, along with other required supporting documentation, reference samples and the prescribed fee, must be sent to:

Variety Registration Office
Canadian Food Inspection Agency
59 Camelot Drive
Nepean, ON K1A 0Y9

Telephone: (613) 221-7533
Facsmile: (613) 228-4552

For further information, please refer to the CFIA website.

## 4. CONTRACT REGISTRATION OPERATING PROCEDURES

### *4.1 Terms of Reference*

Contract registration is available for candidate cultivars where biochemical or biophysical characteristics distinguish them from the majority of registered cultivars of the same kind or species. Further, it must be shown that these characteristics could compromise the end-use suitability of cultivars registered for traditional commodity markets. Thus, to qualify for contract registration, the owner/sponsor of the cultivar must demonstrate the possibility of industry harm if granted an unrestricted registration. Contract registration is only a possibility for varieties which may cause harm based on scientific assessment of agronomic performance, disease reaction or end-use quality, not based on socio-economic factors. The determination of whether a variety has the potential to cause harm is a scientific process where it is determined whether the variety has the potential to cause an adverse effect on the identity of other registered varieties or the variety or progeny thereof may be detrimental to human or animal health and safety of the environment. As a general rule, contract registration is not to be used as a substitute for traditional forms of registration (full or interim) in situations where the PRCWRT has objected to the registration of the candidate cultivar based on deficiency in merit. However, the PRCWRT may suggest that the candidate be considered for contract registration where there is rationale to do so. In this case, an extraordinary meeting of the Contract Registration Committee (CRC) may be required to consider the case and determine if the required conditions for contract registration have been met. The PRCWRT will remind its members of this option when lines have been declined for further testing.

Contract registration may be requested for initial periods of one to three years. Renewal of contract registration for a further term of an additional two years up to a maximum of five years will require:

1. A review of quality management system audits and determination of whether conditions have changed significantly
2. A recommendation from the CRC to the PRCWRT
3. Approval by the Variety Registration Office (CFIA).

If during the period of contract registration it is determined by an individual or organization that conditions of the requirements of contract registration have not been within compliance, there will be a request for review by the CRC. If the justification is upheld, it may be recommended that contract registration be revoked. Contract Registration with no restriction on duration of registration (permanent) may also be granted for varieties for which merit has been established.

The PRCWRT does not have the authority to recommend deregistration of varieties. However, the PRCWRT may advise CFIA of any potential harm that a variety may cause.

### *4.2 Structure and Membership*

The CRC will consist of five individuals appointed by the PRCWRT, with at least one from each of the following disciplines or areas of specialization:

- wheat or durum breeder
- pathology expert
- end-use quality expert

The terms of appointment will normally be for three years. A Chair of the CRC will be chosen from among these five individuals. In cases where confidentiality of data or conflict of interest is identified, the owner of the proposed candidate may request alternative members to be appointed by the PRCWRT Chair. Members of the CRC will have the right to consult with other experts provided that the owner/sponsor (or designate) agrees with the choice. The CRC will act to protect the confidentiality of data where required. There will be cases where confidentiality agreements will be required by the applicant for all participants to assure the legal requirements of the participating organizations.

Consideration of a contract registration application or review may occur at any time of year. Meetings of the CRC will normally be held during the annual PRCWRT meeting in February if there is a reason to do so. Other meetings may be called on 30 days notice or less upon the consensus of the CRC membership.

### *4.3 Eligibility Requirements for Candidates Considered for Testing*

Where a candidate has not previously been tested in co-operative trials, the CRC must receive a written document from the owner/sponsor (or designate) addressing the rationale for contract registration. If this is to be considered at the annual meeting it must be received at least thirty (30) days prior to the meeting. The following points should be noted:

1. The candidate cultivar possesses unique biochemical or biophysical characteristics specific to a defined end-market and could cause industry harm if produced outside of a closed system.
2. An end user/purchaser exists for the contract-registered crop.
3. A closed system for the production of the candidate is achievable.
4. The closed system provides assurance that “off-grade” production shall not enter the normal marketing system for the commodity crop.

Upon the endorsement that testing of the cultivar under contract registration procedures is necessary and appropriate, the Variety Registration Office (VRO) will be informed of the decision and any additional data requirements prescribed by the CRC.

Owners/sponsors or designates of candidates being tested under contract registration procedures are urged to contact the Variety Registration Office for details on the required Quality Assurance Manual, which must be complete before registration is granted. The proponents should share their Quality Assurance Manual and receive the approval of the CGC prior to bringing the variety forward to the Recommending Committee. Consent by the CGC will be required for a wheat or durum line to be considered for contract registration.

Current details of CFIA’s Quality Control System (Q.C.S.) are outlined in the Canadian Food Inspection Agency, Plant Products Directorate, Plant Production Division, Variety Registration Office, *Procedures for the Registration of Crop Varieties in Canada* (www.inspection.gc.ca). In addition to these requirements the owners/sponsors or designates must also provide the following:

1. A risk assessment that will take into consideration the impact of the candidate cultivar on the viability of other classes and registered varieties of wheat and durum, including any health, safety, environment, and marketplace impacts. It is recommended the owners/sponsors or designates consult the CGC at an early stage to discuss risk assessment issues.

2. The risk assessment will also include production, handling, quality control and financial costs such as monitoring including sample acquisition, laboratory analysis and reporting. The owners/sponsors or designates will outline who will cover financial costs associated with monitoring and demonstrate who will be liable for the costs if problems associated with leakage of the contract registered variety from the closed loop system occur. Tolerance levels for such leakage should be identified and agreed to by the relevant industry stakeholders such as the Western Grain Standards Committee.

The assessment of production, handling, quality control and other risks should provide CRC members with information to assess whether the proposed variety is generally high, medium or low risk to non-contract registered classes. This assessment should include (but need not be limited to) the following factors:

| **Factor** | **Comments** | **Assessment: High, Medium or Low Risk** |
|---|---|---|
| Agronomic yield vs alternative varieties? | (e.g.: yield might be high relative to alternative varieties, making this factor "high" risk). | |
| Premium, discount or equivalent price (relative to alternative varieties) confirmed from identified market? | If the candidate is expected to provide a premium, there is less potential for it to be misrepresented as a conventional variety of lesser value. | |
| Identified market prepared to take off-grade product? | This is an absolute necessity as there will be a level of production that will not meet the quality requirements. | |
| Quality differences against the typical class in which the variety could be co-mingled | Need to establish the risk level if co-mingling occurs. | |
| CGC grade designation issues | Are there special requirements for the CGC to allow this variety to be certified for shipments? | |
| Development of a test to allow detection that will be required in a monitoring program | How difficult will it be to detect this new product in a mixed sample? | |
| Geographic region of production | Will this allow selection of the candidate from a limited region or a few specific primary receival points? | |
| Disease impact | Is there a disease of major concern | |
| Health and safety aspects | Are there specific characteristics of this candidate that will pose risks due to health and safety concerns? | |

### *4.4 Contract Registration Recommendations*

If the Contract Registration process is to be considered at the annual meeting, the owner/sponsor or designate of a candidate will provide the Contract Registration Committee (CRC) written notification of their intent to approach the committee at least 30 days in advance of the annual PRCWRT meeting. Appropriate documentation and/or data summaries must be included with the notice. The owner/sponsor or designate of the candidate will be informed of the date and time of the CRC meeting and will be allowed to address the committee. Following the meeting, the CRC will have up to thirty 30 days to rule on the suitability of the candidate for testing under contract registration procedures, prescribe additional data requirements over the minimum specifications, or make a recommendation on

the request for contract registration. The CRC may seek external advice, recognizing that confidentiality may be of extreme importance. A simple majority vote will constitute the decision of the CRC. Votes will be cast in two categories: Support and Object.

The owner/sponsor or designate of the cultivar may contest a CRC decision in two general areas:

1. If the candidate is deemed ineligible for testing under contract registration procedures.
2. If the CRC objects to the contract registration of the cultivar.

If the appellant wishes to appeal further, a three-person appeal board will be selected: one by the appellant, one by the CRC Chair and one neutral party agreed upon by the Appellant and the Committee Chair. The appeal board will choose its own Chair and determine its own procedure. The appellant will pay the expenses of the appeal board. The decision of the appeal board will be binding.

### *4.5 Conduct of Trials & Minimum Data Requirements*

The following are minimum data requirements for contract registration of a candidate cultivar where there has been no prior testing. The CRC may set additional requirements within 30 days following the meeting called to determine the suitability of the candidate for contract registration procedures.

It is a condition that, upon acceptance of a candidate for testing under contract registration procedures, the owner/sponsor or designate agrees that the evaluation protocols and requirements for a Quality Control System by the CRC are appropriate and that these protocols and requirements, however defined, will not justify an appeal.

a) A minimum of two years of testing is required.
b) Testing must be conducted in the region where production is intended to take place. The geographic region(s) may vary in area from all of western Canada to a smaller region within a province.
c) Testing will provide comparisons with the appropriate checks for the crop kind, as currently used in regular registration (co-operative) testing, or as determined by the CRC.
d) Agronomic data must be collected but will be used for descriptive purposes only. No minimum levels of performance are required for agronomic traits. A minimum of eight station-years of agronomic data are required, with a minimum of three station years in each of two calendar years. A minimum of three of the eight station-years of data shall be conducted by an individual or organization that is independent from the candidate proposer, with a minimum of one station year in each of the calendar years tested. The independent test organization must be disclosed to the CRC prior to conducting trials for approval.
e) An independent third party PRCWRT member will be identified by the CRC to inspect all field trials.
f) Disease evaluation will take place in each of two years of testing and shall be conducted under the auspices of the Disease Evaluation Team. Candidates must meet minimum disease resistance requirements in place for traditional cultivars (general registration), unless the owner of the candidate can demonstrate that susceptibility to a particular disease will not endanger production of traditional cultivars in, or adjacent to, the geographic region(s) identified for contract production.
g) Agronomic performance and disease reaction data will not be considered confidential. Grain quality and the trait deemed to cause potential harm would be evaluated in each year of testing,

relative to the appropriate check cultivars for the crop kind. These data will be evaluated by the CRC in consultation with appropriate grain quality experts if deemed appropriate or necessary. The CRC will respect the confidential nature of the data in soliciting expert advice. The purpose of this evaluation is to confirm that the candidate has the quality claimed by the proposer and that such quality requires production within a closed, contract system. Where a candidate cultivar has already been produced in trials and data is available, this will be considered as supplemental data and should not be considered as a substitute for the required two years of testing. However this data can be submitted to the CRC and CGC to determine if it is sufficient. In consultation with the executive of the appropriate Evaluation Teams, the CRC has the jurisdiction to allow supplemental data in lieu of minimum testing.

h) All costs for data collection for Contract Registration shall be borne by the proposers of the candidate cultivar.

i) Recommendations in support of contract registration will be made by the CRC and forwarded to the Variety Registration Office. The Variety Registration Office will examine the request and rule on the applicability of the candidate for Contract Registration. The request will include a review of the Quality Management System for the variety, a variety description, a reference sample and a report on the distinctness, uniformity and stability of the variety.

## APPENDIX A: Co-operative Registration Trial Missions

**Central Bread Wheat Co-op:** Adaptation of candidate cultivars of CWRS wheat to the rust areas of Manitoba and central and southern areas of eastern Saskatchewan.
*Co-ordinator:* Vacant, AAFC - Cereal Research Centre (Winnipeg, MB)

**Western Bread Wheat Co-op:** Adaptation of candidate cultivars of CWRS wheat for the non-rust areas of southern and central Alberta and Saskatchewan including the sawfly area.
*Co-ordinator:* R. Cuthbert, AAFC - Semiarid Prairie Agricultural Research Centre (Swift Current, SK)

**High Yielding Red Wheat Co-op:** Adaptation of candidate cultivars of CPS and CWGP wheat in the black and brown soil zones and the central and southern parkland area.
*Co-ordinator:* F. Kirigwi, Syngenta, (Rosebank, MB); AAFC – Lethbridge Research Centre (Lethbridge, AB)

**Parkland Wheat Co-op:** Adaptation of candidate cultivars of CWRS, CPS and CWES wheat in the northern and central parkland area.
*Co-ordinator:* D.M. Spaner, Univ of Alberta (Edmonton, AB); D.G. Humphreys, AAFC - Cereal Research Centre (Winnipeg, MB)

**Hard White Wheat Co-op:** Adaptation of candidate cultivars of CWWS wheat for all growing areas of the Prairies.
Co-ordinator: R.M. DePauw, AAFC - Semiarid Prairie Agricultural Research Centre (Swift Current, SK)

**Western Soft White Spring Wheat Co-op**: Adaptation of candidate cultivars of soft white spring wheat to the irrigated areas of Alberta and Saskatchewan
*Co-ordinator:* H.S. Randhawa, AAFC - Lethbridge Research Centre (Lethbridge, AB)

**Durum Wheat Co-op:** Adaptation of candidate cultivars of durum wheat to southern and central areas of western Canada.
*Co-ordinator:* R.M. DePauw, AAFC - Semiarid Prairie Agricultural Research Centre (Winnipeg, MB)

**General Purpose Spring Wheat Co-op:** Adaptation of candidate cultivars of spring wheat for the CWGP class in western Canada.
*Co-ordinator:* C.J. Pozniak, Crop Development Centre - University of Saskatchewan (Saskatoon, SK)

**Central Hard Red Winter Wheat Co-op:** The Central has been merged with the Western Winter Wheat Co-op

**Western Winter Wheat Co-op:** Adaptation of candidate cultivars of winter wheat for the CWRW and CWGP classes in the non-rust areas of southern and central Alberta and Saskatchewan, including the sawfly area.
*Co-ordinator:* R.J. Graf, AAFC - Lethbridge Research Centre (Lethbridge, AB)

**Fall Rye Co-op:** Adaptation of candidate cultivars of winter rye in western Canada.
*Co-ordinator:* J. Larsen - AAFC - Lethbridge Research Centre (Lethbridge, AB)

**Winter Triticale Co-op:** Adaptation of candidate cultivars of winter triticale in western Canada
*Co-ordinator:* Vacant

**Western Spring Triticale Co-op:** Adaptation of candidate cultivars of spring triticale to western Canada.
*Co-ordinator:* H.S. Randhawa, AAFC - Lethbridge Research Centre (Lethbridge, AB)

## APPENDIX B: Check Cultivars – 2013

***Central Bread Wheat Co-op*** *(3 replicates)*
Checks:
Carberry
Glenn
Unity (Sm1 pure component)
5603HR

***Western Bread Wheat Co-op*** *(3 replicates)*
Checks:
Katepwa
Unity (Pure component)
Lillian
Carberry
Glenn

Exceptions: Lillian – check for yield of solid-stemmed candidates

***High Yielding Red Wheat Co-op*** *(3 replicates)*
Checks: 5700PR
Glenn
Conquer (Sm1 pure component, note the varietal blend).
HY1615*

Note: after the 2013 meeting, the coordinator, in consultation with the three evaluation teams replaced HY1615 with HY1610 as the preferred check.

***Parkland Wheat Co-op*** *(3 replicates)*
Checks: Katepwa
CDC Teal
AC Splendor
CDC Osler

***Hard White Wheat Co-op*** *(3 replicates)*
Checks: AAC Iceburg
Whitehawk
Snowstar

***Western Soft White Spring Wheat Co-op*** *(4 replicates)*
Checks: AC Reed
AC Andrew
Sadash
Exceptions: AC Andrew – agronomic check only

***Durum Wheat Co-op*** *(4 replicates)*
Checks: AC Avonlea
Brigade
AC Navigator
Strongfield

***General Purpose Spring Wheat Co-op*** *(3 replicates)*
Checks: AC Andrew
Sadash

Pasteur

***Winter Wheat Co-op*** *(4 replicates)*

Checks:

CDC Osprey - CWRW
AC Bellatrix - CWRW
Radiant - CWRW
CDC Buteo - CWRW
Flourish - CWRW
Moats - CWRW
CDC Falcon - CWGP
Broadview – CWGP

***Fall Rye Co-op*** *(4 replicates)*

Checks: Prima
AC Rifle
Hazlet

***Winter Triticale Co-op*** *(4 replicates)*

Checks: Pika
Bobcat

Note: Normally grown as a separate test with the Fall Rye Co-op

***Western Spring Triticale Co-op*** *(4 replicates)*

Checks: Pronghorn
AC Ultima
Brevis
AC Andrew
Pesteur

## APPENDIX C: Measurement of Agronomic Traits

### *Agronomic Traits Measured in each Co-operative Registration Trial*

| | Central Bread Wheat | Western Bread Wheat | High Yielding Red Wheat | Parkland Wheat | Hard White Wheat | Soft White Spring Wheat | Durum Wheat | General Purpose Wheat | Central Winter Wheat | Western Winter Wheat | Fall Rye | Spring Triticale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Replicates | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 4 | 3 | 4 | 4 |
| Grain Yield | + | + | + | + | + | + | + | + | + | + | + | + |
| Heading | - | - | - | + | - | - | - | - | + | + | - | - |
| Maturity | + | + | + | + | + | + | + | + | + | + | + | + |
| Height | + | + | + | + | + | + | + | + | + | + | + | + |
| Lodging | + | + | + | + | + | + | + | + | + | + | + | + |
| Shattering | - | - | - | - | - | + | - | - | - | - | - | - |
| Cleanout | - | - | - | - | - | - | - | - | - | - | - | - |
| Test Weight | + | + | + | + | + | + | + | + | + | + | + | + |
| Kernel Weight | + | + | + | + | + | + | + | + | + | + | + | + |
| Smudge | - | - | - | - | - | - | + | - | - | - | - | - |
| Black Point | - | - | - | - | - | + | - | - | - | - | - | - |
| Starchy Kernels | - | - | - | - | - | - | + | - | - | - | - | - |
| Grade (site basis) | - | - | + | + | - | - | + | - | - | - | - | - |
| KVD | + | + | + | + | + | + | + | + | + | + | + | + |
| Wheat Stem Sawfly Cutting | - | + | - | - | - | - | - | - | - | - | - | - |
| Winter Survival | - | - | - | - | - | - | - | - | + | + | + | - |
| Hagberg Falling Number | - | - | - | - | - | - | - | - | - | - | + | + |

Cultural Conditions: Cultural conditions are representative of farming practices within the surrounding area and should produce seed of quality similar to the commercial commodity. Use of unregistered herbicides, or insecticides and seed applied fungicides should be avoided wherever possible. The use of foliar-applied fungicides or growth regulators is undesirable.

Experimental Design: Lattice or randomized block design, three or four reps, 36 entries or less.

Grain Yield: Plot yields should be converted to a yield per unit area (kg/ha). Equilibrate samples to similar moisture content within test sites. Record all reps.

Days to Heading: 50% heads emerged, recorded 3 times weekly. Calculated from planting date or from January 1, whichever is shorter. Record at least 2 reps.

Days to Maturity: 16 - 18% moisture content - kernels resist denting by fingernail. Recorded 3 times weekly. Calculated from planting date or January 1, whichever is less. Record at least 2 reps.

Plant Height: Straw length measured in cm from ground to top of heads excluding awns after extension growth has ceased. In the event of lodging, plants should be straightened before measurement. Record at least 2 reps.

Lodging: Record on a 1 - 9 scale, where 1 is bolt upright and 9 is completely prone, wherever significant lodging occurs. Record all reps.

Shattering: Record on a 1 - 9 scale, where 1 is undamaged and 9 is completely shattered, wherever significant shattering occurs. Record all reps.

Cleanout: Weight of cleaned sample expressed as a percentage of uncleaned sample. Record on four replicate composite.

Test Weight: Kilograms of cleaned sample (zero chaff) per hectolitre measured under standard conditions, e.g.: Dickey John Grain Analysis Computer, or to CGC standards. Record on composite of all replicates.

Kernel Weight: Milligrams per kernel based on a cleaned sample of at least 200 undamaged kernels from a composite of all replicates.

Smudge and Kernel Black point: Smudged or black pointed kernels expressed as a percentage by count or by weight of at least 10 g of the cleaned four rep composite wherever non-trace amounts of smudge or blackpoint are noted.

Percent Starchy Kernels: As determined by the Industry Services division of the Canadian Grain Commission from the cleaned composite of all replicates.

Sample Grade: As determined by Industry Services division of the Canadian Grain Commission from a composite of all replicates.

Winter Survival: Estimated to nearest 5% after spring regrowth wherever there is winterkill. Record all replicates.

## APPENDIX D: Guidelines for Disease Resistance in Wheat and Triticale

(Revised January 2010)

The operating guidelines for the Disease Evaluation Team (DET) of the PRCWRT are presented below for the various classes of Canadian wheat. The "Do-Not-Object-To" level of resistance described in the table is the level that would prevent significant economic loss. This is the minimum level of resistance expected in registered cultivars. The disease ratings for registered cultivars can be found in provincial seed guides, based on meetings of the Western Committee of Plant Diseases. The most common level of resistance presently found in registered cultivars is the level considered achievable within breeding programs. The "Do-Not-Object-To" level of resistance is the minimum acceptable level designated by the WRT DET. This level is agreed upon by breeders and pathologists for each disease and may change depending on virulence changes in the pathogen and availability of resistance. The "Do-Not-Object-To" level of resistance may not be sufficient to provide adequate disease control for some pathogens.

For each Priority 1 disease in each class of wheat or triticale, ratings by the DET are primarily based on the assessment of three years of disease data. The DET will "Object to" the registration of candidate cultivars that do not meet the "Do-Not-Object-To" level of resistance. The DET will "not object to" the registration of candidate cultivars that meet the "Do-Not-Object-To" level of resistance. The DET will "Support" the registration of candidate cultivars that exceed the "Do-Not-Object-To" level of resistance for one or more diseases and meet "Do-Not-Object-To" level of resistance for the other Priority 1 diseases.

**Disease priorities are defined as follows:**

Priority 1: Those diseases for which Co-op testing is being done and the "Do-Not-Object-To" level of resistance is necessary for support for registration.
Priority 2: Those diseases for which breeding and pathology research is being done in western Canada and a minimal level of resistance is desirable to reduce economic loss to producers.
Priority 3: Other diseases of wheat to which little or no breeding or pathology research is being done in western Canada but which are of localized or temporal significance.

A five point rating system of R, MR, I, MS and S is used to describe Priority 1 disease ratings where R= Resistant, S= Susceptible, M= Moderate, and I= Intermediate. The equivalent levels in provincial seed guides are: R=Very Good, MR=Good, I=Fair, MS=Poor, S=Very Poor.

The "Do-Not-Object-To" requirements for the Priority 1 diseases are listed in Table 1 for the CWRS, CPS, CWGP, CWAD, CWES, CWHW, CWSWS, CWRW, Triticale, and Spelt classes. Pathologists running Co-op disease tests will identify the check cultivars or selected check line(s) which represent the "Do-Not-Object-To" level of resistance for a particular Co-op. In cases in which the predominant resistance in a wheat class is susceptible and therefore the "Do-Not-Object-To" level of resistance is susceptible, routine Co-op disease testing may be suspended and instead selective testing would be done by special request of breeders where the potential for resistance in the line or lines is demonstrated by a combination of pre-Coop and parental data. A minimum disease level should be attempted before testing is resumed.

**External Data**

For external data to be considered by the DET, it must be supplied by a recognized body or institution using procedures consistent with those used in Co-op tests. The required criteria include three years of data, the use of inoculum with appropriate races for the region, identification of the test location, the inclusion of a familiar susceptible check and a check with the "Do-Not-Object-To" level of resistance, and a description of the evaluation method. The DET will vote on the acceptability of external data. If the data is deemed unacceptable, the DET will report that no decision could be made because of insufficient data. If the data is acceptable, the DET will proceed to consider the data and vote as normal.

**Establishing Disease Guidelines for New Classes and New Priority 1 Disease**s

Priority 1 diseases are those diseases which can be controlled by genetic resistance and which are considered to cause harm significant enough to warrant regulation through the registration process. Priority 1 diseases are those diseases for which Co-op disease test data or external data are required and for which the "Do-Not-Object-To" level of resistance is necessary for support for registration. In general, Co-op disease testing is provided for major grain classes. In the case of new or minor classes of grain occupying or predicted to occupy a small acreage, external data collected in the prescribed manner may be requested. At the time of the development of a new class of wheat, Disease Guidelines will be established by the DET in consultation with the PRCWRT. Actual or forecasted area of production of significant acreage will be considered for the development of disease guidelines.

**Disease Reports**

DET members appointed by the chairperson prepare the disease reports. A separate report is prepared for each Co-operative test. Prior to the PRCWRT meeting, a draft report is prepared that summarizes disease data for all entries in the Co-op. Recommendations for the advancement of lines are given on first and second year entries. A single summary disease rating of the three years data for each disease is provided on a five point rating scale of R, MR, I, MS and S where R= Resistant, S= Susceptible, M= Moderate, and I= Intermediate. Recommendations on support for registration are given on lines proposed for registration. Disease assessments and recommendations are discussed at the PRCWRT DET meeting and reports are updated prior to submission for inclusion in the minutes.

**Members in charge of disease and reporting (See Appendix J for full DET membership list).**

| Members | Disease Responsibility | Disease Report(s) |
|---|---|---|
| Therese Despins | Common bunt | |
| Myriam Fernandez | Leaf spot diseases | Western Bread Wheat, Triticale |
| Tom Fetch[1] | Stem Rust | General Purpose |
| Denis Gaudet | | Winter Wheat, SWS |
| | Leaf spot diseases, FHB | Central Bread Wheat |
| Steve Haber | | Durum Wheat |
| Ron Knox | | Hard White |
| Brent McCallum[2] | Leaf Rust | Parkland, HYr (CPS/CWES) |
| Curt McCartney | Rust (Winter Wheat) | Spelt |
| Jim Menzies | Loose Smut | |

[1] Chairperson
[2] Secretary

***"Do-not-object" guidelines for Priority 1 diseases of the major classes of wheat and triticale in Western Canada.***

| | | | | | | | | All Winter Wheat | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Disease** | **CWRS** | **CPS** | **CWGP** | **CWAD** | **CWES** | **CWHW** | **SWS** | **East** | **West** | **Triticale** | **Spelt** |
| Leaf Rust | MR | I | I | MR | I | MR | - | I | (I 2012) | MR | MR |
| Stem Rust | I | I | I | MR | MR | I | - | I | (I 2012) | MR | - |
| Common Bunt | I | I | I | MR | I | I | - | (I 2012) | MR (I 2012) | I | MS |
| FHB | I | I | I | MS | I | I | - | - | - | MS | MS |
| Leaf spots | MS | MS | MS | I | MS | MS | - | - | - | - | MR |
| Loose Smut | MR | MS | MS | MS | MR | MS | - | - | - | - | - |
| Stripe Rust | - | - | - | - | - | - | MR | - | - | - | - |
| Powdery Mildew | - | - | - | - | - | - | I | - | - | - | - |
| Black Point | - | - | - | - | - | - | MS | - | - | - | - |

For the disease resistance ratings of many of the registered cultivars, please refer to the Western Committee on Plant Diseases section on the Western Forum on Pest Management website (www.westernforum.org).

## APPENDIX E: Disease Screening Protocols

**Protocol for evaluating reaction to loose smut in wheat** (Jim Menzies)

Ten to 12 seeds of each wheat line are sown per hill plot in May at the CRC field station at Glenlea, Manitoba. At heading, three spikes of each hill are selected for inoculation. The chosen spikes are at mid-anthesis (the anthers at either end of the spike are dehisced, while those in the middle are yellow). About 1 cm is cut off the tips of each inoculated spike with scissors to mark the inoculated heads.

The partial-vacuum method described by Nielsen (1983) is used for inoculation. With this method, the spikes are placed in an inoculation cylinder and immersed under vacuum in a suspension of water and teliospores of *U. tritici* at a concentration of about 4 g teliospores per L of water. The vacuum is maintained for two to three seconds and then released, allowing the teliospore suspension to drain into a reservoir. Without removing the spikes from the inoculation cylinder, this procedure is immediately repeated once.

The loose smut races T2, T9, T10, and T39 (Nielsen 1987) are employed in the inoculum suspension; each at 1 g teliospores $L^{-1}$ of water. These four races represent the common races of *U. tritici* in western Canada (Thomas and Menzies, *unpublished data*). A fresh mixture of inoculum is prepared each day.

Each spike is harvested and threshed individually. The seed are sown in a soil bed in the greenhouse during the following winter. At heading, the numbers of healthy and smutted plants are recorded and the percentage of smutted plants determined.

Nielsen, J. 1983. Spring wheats immune or highly resistant to *Ustilago tritici*. Plant Dis. 67: 860-863.
Nielsen, J. 1987. Races of *Ustilago tritici* and techniques for their study. Can. J. Plant Pathol. 9: 91-105.

**Protocol for evaluating reaction to common bunt in wheat** (Denis Gaudet)

Spring wheat bunt reaction nurseries are sown on fallow land at the earliest possible date, which is about mid April in Lethbridge. Winter wheat is as late as possible to ensure good winter survival. Seeds are sown to a depth of 6 cm in cool soil, with row lengths from 4.5-6 m. Inter-row spacing is set at 25 cm. Guard rows at the start of the plot are infested with common bunt to pre-contaminate the seed drill. Check lines are included every tenth row. At maturity, each plot is visually evaluated for bunt and percent bunt infection estimated for each row. The test is seeded at two locations, one under dryland conditions and one with access to irrigation.

Seed is inoculated to excess with a 1:1 composite of the bunt species *Tilletia tritici* and *T. laevis* in a 1:1:1:1:2:2 mixture of the races T-1, T-6, T-13, T-19, L-1, L-16. This composite represents the virulence spectrum of most locally collected bunt isolates. The population dynamics of the races may vary from year to year and location to location depending on environmental conditions. Spores are collected by grinding bunt infested heads with a Wiley mill grinder fitted with a 4 mm screen. Seed envelopes or trays are then infested with the mixed spore mixture within the seed envelope (0.04 g bunt/10 g seed). The bunt is not pre-weighed but only scooped into the envelope at an estimated amount. Envelopes are bound together with elastic bands and inserted in seeding trays. The trays are then placed on an agitator and allowed to agitate until seed is thoroughly infested. Envelope size and elastic band placement must be considered to ensure seed can freely agitate within the envelope while on the shaker.

Just prior to maturity, as the wheat is turning, plots are visually rated for bunt. Care must be taken to check the shorter tillers which are more prone to being bunted. The major check line Neepawa is inserted every twenty rows. Minor check entries are inserted into the nursery occurred every hundred rows. The minor checks are Barrie, Fielder, Foremost, Laura, and McKenzie. The reactions of the lines are divided into 6 classes, as defined by bunt scores compared to the intermediate major check, Neepawa. Lines falling within a single standard deviation on either side of the Neepawa mean are defined as intermediate. Lines falling within 2 standard deviations around the Neepawa mean are moderately resistant and moderately susceptible. Lines greater than 2 standard deviations to the left of Neepawa are resistant, whereas lines 2 standard deviations to the right are susceptible. All lines greater than 3 standard deviations to the right of the Neepawa mean are classed as highly susceptible.

**Protocol for evaluating reaction to wheat stem rust** (Tom Fetch)

Co-op entries are screened in field stem rust nurseries (adult stage) as well as in seedling tests in the greenhouse. Data from both sources are considered in determining a rating.

Co-op entries in the field stem rust nurseries are seeded in short rows, between spreader rows consisting of a mix of susceptible lines. Spreader rows are inoculated with a mixture of stem rust races (TPMKR, TMRTK, RKQSR, RHTSK, MCCFR, RTHJT, and QTHST). These races were chosen to represent a wide range of virulence to ensure adequate levels of resistance are maintained in wheat cultivars, i.e. More than one *Sr* gene for resistance.

The field nurseries are rated for disease when symptom expression is optimal, as indicated by the reaction of the check cultivar 'Columbus'. Two ratings are given for each line; (1) severity of the disease expressed as percentage of stem coverage, and (2) reaction or pustule type ranging from R - RMR - MR - MRMS - MS - MSS - S. Infection levels may vary from year to year depending on environmental conditions, but the inoculum mixture is the same. The cultivar 'Columbus' is intermediate in resistance, which corresponds to the "Do Not Object" level.

For seedling tests, Co-op entries are seeded in hills using fibre flats, and inoculated at the first leaf fully expanded stage (7-8 d). Races TPMKR, TMRTK, RKQSR, RHTSK, MCCFR, RTHJT, and QTHST are individually inoculated for each entry. Inoculation and incubation protocols are published and available online (http://pubs.nrc-cnrc.gc.ca/tcjpp/cjplant27-04.html; Fetch, T. pp 572-580). Lines are rated for infection type on a 0-4 scale (0, ;, 1, 2, 3, 4). Reaction types of 0, ;, 1, and 2 are considered resistant, and types 3 and 4 are usually considered susceptible ($3^-$ reactions may show some level of resistance).

**Protocol for evaluating reaction to wheat leaf rust** (Brent McCallum)

Co-op entries are screened in a field leaf rust nursery (adult stage) as well as in seedling tests indoors. Data from both sources are considered in determining a rating.

The field leaf rust nursery is seeded in short rows with spreader rows of a susceptible variety at regular intervals. Spreader rows are inoculated with a mixture of leaf rust races that were collected during the leaf rust disease survey from the previous year. To determine the composition of this inoculum, check the wheat leaf rust publication from the previous year in the Canadian Journal of Plant Pathology.
The field nursery is rated for disease when symptom expression is optimal. Two ratings are given for each line; (1) severity of the disease expressed as percentage of leaf coverage, (2) reaction or pustule type ranging from R - RMR - MR - MRMS - MS - MSS - S.

Seedling tests: Lines are seeded in flats and inoculated at the two leaf stage. Races MBDS, TJBJ, MBR, MGB are used for the seedling test. Lines are rated for pustule type ;, 1, 2, 3, 4. Reaction types ;, 1, and 2 are considered resistant and types 3 and 4 are usually considered susceptible (some type 3 reactions may show some level of resistance). Inoculation and rating methods are detailed in the annual wheat leaf rust survey publication.

**Protocol for evaluating reaction to leaf spots** (Jeannie Gilbert)

Leaf spot reaction of Co-op materials is assessed on plots that have only been exposed to natural field inoculum. Three replicates at the "C" level and two at the "B" level are planted. Percent severity of flag (F) leaves and the F-1 leaves are recorded between milk and soft dough stage of ripeness. The prevalent leaf spot pathogens infecting the Co-op entries are subsequently determined from leaf tissue samples collected from the check varieties. Samples are collected at the time of scoring, surface sterilized, then incubated under cool white light for 5 days at 20° C to promote pathogen sporulation and facilitate identification of the organism(s) causing disease.

**Protocol for evaluating reaction to Fusarium head blight in the field** (Jeannie Gilbert)

Identify rows at 50% anthesis (spray paint of different colours to denote each date). Inoculate plants with 50 ml spore suspension (50,000 conidiospores $ml^{-1}$) per meter of row when 50% heads are in anthesis. Inoculate the same rows 3-4 days later to infect later tillers. Mist or irrigate in the evening of each inoculation.

Visual Rating Index (VRI):
In the field, rate infected rows using two digits at 21 d after inoculation. The first digit/number (0-10 scale) represents the incidence (percent of heads with infection), while the second digit/number (0-10 scale) represents the severity (average amount of infection on infected heads). The VRI is the product of Incidence × Severity.

In the greenhouse, screening may be done by spray inoculation or by single floret inoculation (SFI). The spray method closely follows the field inoculation procedure, except that the head is subjected to inoculum (approximately 2 ml/head at 50,000 conidiospores $ml^{-1}$) and humidity just once. SFI provides a measure of spread of the fungus in the head. 10ul of a spore suspension of 50,000 conidiospores $ml^{-1}$ is placed inside the floret at anthesis. Plants are provided with 100% RH for 24 h. Rating is done 21 d later as percent infected spikelets.

Assessment - Disease development is especially dependent on the right environmental conditions. High temperatures on the day of inoculation may cause little disease to develop. Check varieties are planted at regular intervals throughout the nursery and ratings have to take conditions and check reactions into account. A low score may mean escape rather than resistance. It is therefore very difficult to make an arbitrary statement about levels of disease being rated as MS or MR etc, although we are attempting to. Relative to the checks the level required for each rating category may change from year to year.

## APPENDIX F: Measurement of Quality Traits

### *Quality Factors Measured in each Registration Trial*

| | | Central Bread | Western Bread | Parkland | Hard White | High Yielding | Extra Strong | Soft White Spring | General Purpose | Durum | Central Winter | Western Winter | Winter Rye | Spring Triticale |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WHEAT | Grade | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | | |
| | Test weight, kg/hl | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Kernel weight, mg | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Hard Vitreous Kernels, % | | | | | | | | | ✔ | | | | |
| | Wheat protein, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | | |
| | Falling Number, seconds | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Particle Size Index, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | | |
| FLOUR | Flour (semolina) protein, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | | |
| | Protein loss, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | Amylograph Peak Viscosity, BU | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | Flour Yield, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | Moisture content - flour, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | Flour Ash, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | AGTRON color, units | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | Starch damage, megazyme units | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| SEMOLINA | Semolina Yield, % | | | | | | | | | ✔ | | | | |
| | Total Yield (Semolina + flour) % | | | | | | | | | ✔ | | | | |
| | Semolina Ash, % | | | | | | | | | ✔ | | | | |
| | Wet Gluten, % | | | | | | | | | ✔ | | | | |
| | Dry Gluten, % | | | | | | | | | ✔ | | | | |
| | Gluten Index, % | | | | | | | | | ✔ | | | | |
| | Yellow Pigment, ppm | | | | | | | | | ✔ | | | | |
| | Color: L*, a*, b* - Minolta units | | | | | | | | | ✔ | | | | |
| | Visual Specks per 50cm² | | | | | | | | | ✔ | | | | |
| FARINO GRAPH | Water Absorption, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | Dough development time, min. | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | Mixing tolerance index, units | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| | Stability, min. | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | ✔ | ✔ | | |
| ALVEO GRAPH | P value, mm | | | | | | | ✔ | | ✔ | | | | |
| | L value, mm | | | | | | | ✔ | | ✔ | | | | |
| | P/L Ratio | | | | | | | ✔ | | ✔ | | | | |
| | W value, ergs | | | | | | | ✔ | | ✔ | | | | |
| BAKE TESTS | CSP or Remix-to-Peak | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ | ✔ | | |
| | Bread Loaf volume, cm³ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ | ✔ | | |
| | Appearance, scale 1 - 10 | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ | ✔ | | |
| | Crumb Structure, scale 1-10 | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ | ✔ | | |
| | Crumb Color, scale 1 –10 | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ | ✔ | | |
| | Water Absorption, % | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ | ✔ | | |
| | Bread Mixing Energy, Whr/kg | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ | ✔ | | |
| | Bread Mixing Time, min | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ | ✔ | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPAG HETTI | SPAG 70 or 90 degree | | | | | | | | | ✔ | | | | |
| | Color - L*, a*, b* - Minolta units | | | | | | | | | ✔ | | | | |
| | Cooking Quality – Peak Force, g | | | | | | | | | ✔ | | | | |
| NOODLE TESTS | Color – L*, a*, b* - Minolta units | ✔ | ✔ | ✔ | ✔ | ✔ | | | | | | | | |
| | Peroxidase Activity, | ✔ | ✔ | ✔ | ✔ | ✔ | | | | | | | | |
| | Polyphenol Oxidase Activity | ✔ | ✔ | ✔ | ✔ | ✔ | | | | | | | | |
| | Noodle texture, maximum cutting stress, g/mm² | ✔ | ✔ | ✔ | ✔ | ✔ | | | | | | | | |
| | Noodle texture, resistance to compression, % | ✔ | ✔ | ✔ | ✔ | ✔ | | | | | | | | |
| | Noodle texture, recovery, % | ✔ | ✔ | ✔ | ✔ | ✔ | | | | | | | | |
| SOFT | Alkaline water retention capacity, % | | | | | | | ✔ | | | | | | |
| | Cookie Spread Test, Spread, mm | | | | | | | ✔ | | | | | | |
| | Cookie Spread Test, Spread Ratio | | | | | | | ✔ | | | | | | |
| | Pelshenke, units | | | | | | | ✔ | | | | | | |

Quality data is compiled from the results of tests performed in the Grain Research Laboratory. These tests are conducted according to standardized procedures and methods. Each time a test is performed on a composite sample, the method for that test is closely followed. That way, results are reliable and accurate and quality data can be compared from year to year.

Unless otherwise specified:

- Analytical results for wheat are reported at 13.5% moisture content.
- Analytical results for flour and semolina are reported at 14.0% moisture content.
- AACC methods cited are from The American Association of Cereal Chemists (AACC): Approved Methods of the American Association of Cereal Chemists, Tenth Edition, 2000.
- ICC methods cited are those of the International Association for Cereal Science and Technology (ICC): ICC Standards: Standard Methods of the International Association for Cereal Science and Technology, 7th supplement, 1998.
- Grade determinants and procedures are those used by Industry Services, Canadian Grain Commission (CGC).

**AGTRON colour**
The AGTRON colour of flour and durum wheat semolina is determined using AACC Method 14-30. An AGTRON direct reading reflectance spectrophotometer is used.

**Alveogram**
For all classes with the exception of CWAD, ICC Standard Method No. 121 is followed, using the constant pressure Chopin Alveograph Model MA82. Total mixing time is modified depending on wheat class as follows: CWES 8 minutes; CWRS 7.5 minutes; CWRW 7 minutes; CPSR, and CPSW 6.5 minutes; and CWSWS and CEWW 6 minutes. Chopin standard procedure using a Chopin Alveograph NG is followed for CWAD. Total mixing time is 8 minutes. Following milling, flour samples are stored for a minimum of seven days prior to analysis.

**Amylograph peak viscosity**
Sixty-five grams of flour and 450 ml of distilled water are used with the Brabender amylograph and the pin stirrer. Other details are as in AACC Method 22-10. Peak viscosity is reported in Brabender units.

**Ash content**
To determine wheat, flour or semolina ash content, AACC Method 08-01 is used. Samples are incinerated overnight in a muffle furnace at 600°C.

**Alkaline water retention capacity (AWRC)**
Alkaline water retention capacity (AWRC) is determined using AACC Method 56-10. Centrifugation is done at 1000 x g using a swinging bucket rotor.

**Canadian short process baking test**
The Canadian short process baking test, as described by Preston et al. (1982), Canadian Institute of Food Science and Technology Journal 15:29-36, is followed, using 150 ppm ascorbic acid as the oxidant. Loaves are produced from 200 grams of flour in baking pans with cross-sectional dimensions similar to Canadian commercial baking pans. Loaf volume is reported on a 100-gram flour basis. Mixing energy is measured in watt-hours per kilogram (W-h/kg) with the modification that the National mixer replaced the GRL mixer as the official mixer for CSP bread evaluation.

**Cookie test**
The cookie test is performed according to AACC Method 10-50 D.

**Dry gluten content-semolina**
Semolina dry gluten content is determined using AACC Standard Method 38-12A, following the procedure for whole meal.

**Extensogram**
This test is conducted using AACC Method 54-10 with the exception that the dough is not stretched at 90 minutes and, for CWES, the total dough mixing time is fixed at 2 minutes. Length is in centimetres, height is in Brabender units (BU), and area is in square centimetres. The extensograph is set so that 100 Brabender units equal a 100-gram load.

**Falling number**
The falling number is determined on a 7-gram sample of ground wheat or semolina by AACC Method 56-81B. A 300-gram sample of wheat is ground in a Falling Number Laboratory Mill 3100 according to ICC Standard Method No. 107.

**Farinogram**
This test is conducted using AACC Method 54-21, following the procedure for constant flour weight using the small bowl.

- Farinograph absorption is the amount of water that must be added to flour to give the required consistency. It is reported as a percentage.
- Dough development time is the time required for the curve to reach its maximum height reported to nearest 0.25 minute.
- Mixing tolerance index (MTI) is the difference, in Brabender units, between the top of the curve at the peak and the top of the curve measured 5 min after the peak is reached.
- Stability is defined as the difference in time, to the nearest 0.5 min, between the point at which the top of the curve first intersects the 500-BU line (arrival time) and the point at which the top of the curve leaves the 500-BU line (departure time).

For CWES, farinograph absorption is determined at 63 rpm. Remaining quality parameters are measured at 90 rpm based on absorption obtained at 63 rpm. For additional details, see the Farinograph Handbook, AACC, 1960.

**Flour yield**
Wheat is cleaned, scoured and tempered overnight to optimum moisture as described by Dexter and Tipples (1987), Milling 180 (7):16, 18-20. All millings at the GRL are performed in rooms with environmental control maintained at 21$^{o}$C and at 60% relative humidity.

- Common wheat is milled on an Allis-Chalmers laboratory mill using the GRL sifter flow as described by Black et al. (1980), Cereal Foods World 25:757-760. Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis. To allow direct comparison of flour refinement and end-product

suitability between lines, flour for testing is prepared at a constant extraction rate (74% unless stated otherwise) by elimination of a portion of the least refined flour streams.

**Gluten index-semolina**
Durum semolina gluten index is determined using AACC Standard Method 38-12, following the procedure for whole meal.

**Hard vitreous kernels (HVK)**
The percentage of hard vitreous kernels (HVK) is determined by examination of a sieved 25-gram sample for the natural translucency associated with hardness. Kernels are classed as HVK or non-vitreous as defined in the Canadian Grain Commission's Official Grain Grading Guide, Chapter 4, Wheat.

**Moisture content-flour**
To determine the moisture content of flour, a 10-gram sample is heated for 1 hour in a semi-automatic Brabender oven at 130°C.

**Moisture content-wheat**
The moisture content of wheat is determined using the Model 919 moisture meter calibrated against the AACC method 44-15A, following the procedure for two-stage air-oven.

**Noodle colour**
Colour is determined on a raw noodle sheet using a Hunterlab XE spectrocolorimeter using the CIE (1976) L*, a* and b* colour scale with a D65 illuminant.
L* is a measure of brightness.
a* indicates red-green chromacity. Positive values indicate increased redness.
b* indicates yellow-blue chromacity. Positive values indicate increased yellowness.

**Noodle preparation**
Noodles are prepared following the method of Kruger et al (1994), Cereal Chemistry 71:177-182. Yellow alkaline noodles are prepared with a 1% kansui reagent (9:1 sodium and potassium carbonates) at a 32% water absorption. White salted noodles are prepared using a 1% sodium chloride solution at a 30% water absorption level to maintain proper dough crumb and sheeting characteristics.

**Peroxidase Activity**
Peroxidase activity is measured by the method of Hatcher and Barker (2005) Cereal Chem.(In press).

**PolyPhenol Oxidase Activity**
Polyphenol Oxidase (PPO) activity is measured by the method of Hatcher and Kruger (1993) Cereal Chem.70:51-55.

**Protein content (N (nitrogen) x 5.7)**
Protein content (N (nitrogen) x 5.7) of the composite samples is determined by combustion nitrogen analysis (CNA). Samples are ground on a UDY cyclone sample mill fitted with a 1.0-millimetre screen. Sample size is 250-milligrams and samples are not dried before analysis. Protein content is calculated from total nitrogen as determined on a LECO Model FP-428 CNA analyzer calibrated with EDTA and reported on a constant moisture basis. Moisture content is determined by the AACC Method No. 44-15A, following the procedure for one-stage air-oven. The method for Dumas CNA analysis is explained in Williams, Sobering, and Antoniszyn. 1998. Protein testing methods at the Canadian Grain Commission. In: Wheat Protein Symposium: proceedings; 1998 March 9-10; Saskatoon, Saskatchewan

**Particle size index (PSI)**
Particle size index (PSI) is a measure of the texture of a wheat kernel. AACC Method No. 55-30 is modified by using a UDY cyclone sample mill fitted with a feed rate regulator and a 1.0-millimetre screen. A 10-gram sample from 22 gram of ground, blended wheat is sieved over a US Standard 200-mesh sieve for 10 minutes in a Ro-tap sieve shaker. The weight of throughs X 10 is recorded as the PSI.

**Remix-to-peak baking test**
The remix-to-peak baking test is a modification of the remix baking test of Irvine and McMullan (1960), Cereal Chemistry 37:603-613, as described in detail by Kilborn and Tipples (1981), Cereal Foods World 26:624-628. Dough is mixed to peak consistency at the second mixing stage.

**SDS sedimentation**
SDS sedimentation volumes are determined by a modified version of Axford and Redman (1979), Cereal Chemistry 56:582-584, using 3% SDS as described by Dexter et al. (1980) Canadian Journal of Plant Science 60:25-29.

**Semolina colour**
Durum semolina colour is determined using a Minolta Model CM-525i spectrophotometer and expressed as L*, which indicates lightness, a* which represents redness, and b* which represents yellowness. L*a*b* is referred to as the CIELAB colour space. Differences in particle size have a significant effect on colour readings. Semolina samples with similar particle size distributions are used for comparability.

**Semolina yield**
Durum wheat is milled on a four stand Allis-Chalmers laboratory mill in conjunction with a laboratory purifier as described by Black (1966), Cereal Science Today 11:533-534, 542. The mill flow is described by Dexter et al. (1990), Cereal Chemistry 67:405-412. Semolina is defined as having less than 1% pass through a 149-micrometre sieve. Milling yield, the combination of semolina and flour, and semolina yield are reported as a percentage of the cleaned wheat on a constant moisture basis. To allow direct comparison of semolina refinement and spaghetti colour between lines, semolina for testing is prepared at a constant extraction rate (65% unless stated otherwise) by elimination of a portion of the least refined semolina streams.

**Spaghetti**
Spaghetti is processed from semolina using the micro-processing method of Matsuo et al (1972), Cereal Chemistry 49:707-711, and dried at 70°C and 90°C in a computer controlled laboratory-scale dryer (AFREM, Lyon, France).

**Spaghetti colour**
Spaghetti colour is determined using a Minolta Model CM-525i spectrophotometer and expressed as L* which indicates lightness, a* which represents redness, and b* which represents yellowness. L*a*b* is referred to as the CIELAB colour space. For colour measurement, a 5-centimetre band of spaghetti strands is mounted on white cardboard using double-sided tape.

**Spaghetti cooking quality**
Spaghetti cooking quality as measured spaghetti firmness is determined using the Stable MicroSystems TA.XT2i Texture Analyser following AACC Method 66-50, with a crosswise cut through 10 strands of spaghetti cooked to optimum.

**Speck count**
Speck count is determined as described by Dexter and Matsuo (1982), Cereal Chemistry 59:63-69.

**Starch damage**
Starch damage is determined using AACC Method 76-31 Damaged Starch: Spectrophotometric Method. Starch damage is expressed as a percentage of flour weight. The method is also referred to as the MegaZyme method.

**Test weight**
Test weight is determined using the Schopper chondrometer equipped with a 1-Litre container. The weight in grams of the measured litre of wheat is divided by 10. The result is reported in kilograms per hectolitre (kg/hL) without reference to the moisture content.

**Texture characteristics - noodles**
Texture measurements were carried out using a computer-assisted Stable Micro Systems TA-XT2i Texture Analyser and represent the average of four replicate cookings in which each cook evaluated five sets of noodles. Characteristics were determined as per Oh, N.H. et al. (1983), Cereal Chemistry 60:433-438.

- Maximum cutting stress (MCS, $g/mm^2$) reports the bite or firmness of the cooked noodle ($g/mm^2$)
- Resistance to compression (RTC, %) correlates with the noodle's firmness and chewiness.
- Recovery % correlates with the noodle's firmness and springiness.

**Weight per 1000 kernels**
Broken kernels and foreign material are handpicked from a sample to create a cleaned sample. The number of kernels in a 20-gram subsample of the cleaned sample is then counted using an electronic seed counter.

**Wet gluten content -flour**
ICC Standard Method No. 137/1 is followed using the Glutomatic System 2200 with 80-micrometre metal sieves.

**Wet gluten content -semolina**
Semolina wet gluten content is determined using AACC Standard Method 38-12, following the procedure for whole meal.

**Yellow pigment content**
Yellow pigment content of durum wheat and semolina is determined using AACC Method 14-50.

## APPENDIX G: Data Release Policy

***This policy is under review.***

Operating Procedures used by the PRCWRT will be available.

The PRCWRT minutes will be bound into a report for distribution to each registrant of the annual meeting. Included in this report will be the voting results (Evaluation Team and Committee votes) for each candidate cultivar considered. The report will consist of the meeting minutes of each Evaluation Team and the Committee.

Reports will be available to all registrants of the meeting, usually for a fee. A disclaimer indicating the restricted distribution of the report and limitations of the data will be included on the first page of each document.

Developers, owners and marketing institutions may use the data for their lines without request for permission. Comparisons may only be made with check cultivars in the trials in which the candidate was evaluated.

Data for candidates supported for registration may be used in "provincial government variety guides" without request for permission.

***Disclaimer to be published with the PRCWRT minutes:***

The data contained in these documents are the copyright property of the Prairie Recommending Committee for Wheat, Rye and Triticale (PRCWRT). The information contained herein may not be reproduced, published or disseminated in any form other than in its entirety, without the express written consent of the PRCWRT.

The data contained in this document are collected from several sources. The PRCWRT does not guarantee the veracity of subsets of these data.

The members/experts of the PRCWRT evaluate the merit of genotypes/cultivars using a pool of performance parameters collected over several years and multiple locations. Any subset of these data cannot be considered a reliable indication of overall merit.

Requests for permission to use portions of this document must be forwarded, in writing, to the PRCWRT Chair. Guidelines to the Chair in granting permission to use portions of PRCWRT data are as follows:

a) Permission to use data subsets will be refused in situations where, in the considered opinion of the Chair, the data will be presented in a misleading manner.
b) The data for the checks is considered public domain and a request for use will be approved unless it conflicts with point (a).
c) The use of data specific to entries may be approved with the express written consent of the relevant breeder/sponsor.
d) The Chair, in granting permission to use the data, will consider and respect information that is proprietary.
e) If Registration Trial data is used outside of the PRCWRT, proper acknowledgement of who provided the data should be made.

## APPENDIX H: Conflict of Interest Guidelines

The PRCWRT has as one of its mandates, the responsibility "to advise on the performance of lines in registration trials and make recommendations regarding the registration of candidates to the Variety Registration Office, Canadian Food Inspection Agency." While members are expected to vote impartially, abstaining from a vote is appropriate when sound ethical judgment indicates a 'Conflict of Interest'.

A Conflict of Interest arises when an individual acting in an official capacity (public official, employee, professional, etc.) has private or personal interests sufficient to appear to influence the objective exercise of their duties. Conflicts of Interest interfere with professional responsibilities by clouding objective, professional judgment (Michael McDonald, Centre for Applied Ethics, University of British Columbia).

There are three key elements in defining a Conflict of Interest:

- **Private or personal interest:** The pursuit of private or personal interests does not create a conflict of interest unless it occurs during the exercise of official capacity.

- **Exercise of official capacity:** Duties and obligations that are part of an office or official capacity must prevail over private or personal interests.

- **Responsibility to use objective professional judgment:** Professionals are expected to provide sound, objective and independent advice. Factors that interfere (or appear likely to interfere) with professional objectivity are a matter of legitimate concern to those who rely on this advice.

In addition to *actual* Conflicts of Interest, *apparent* and *potential* conflicts should be avoided.

- **Apparent Conflict of Interest:** a situation in which a reasonable person would believe that the professional's judgement is likely to be compromised.

- **Potential Conflict of Interest**: a situation that could develop into an actual conflict of interest.

The key in discovering a personal Conflict of Interest is to determine if the situation is likely to interfere, or appears to interfere, with the independent judgement expected in performing your official duties. Trust is the core issue. Conflicts of Interest involve an abuse (actual or potential) of the trust that people have in professionals. In addition to direct damage to particular clients and employers, Conflicts of Interest injure the entire profession by reducing the confidence that people have in professionals.

An excellent diagnostic tool is the "trust test": *Would relevant others (employer, clients, colleagues, general public) trust my judgment if they knew I was in this situation?*

When a personal Conflict of Interest is recognized, the ethical responses are:

- Reveal your private interest to the relevant parties.
- Remove yourself from the decision making process or advice-giving role.

## APPENDIX I: The Canadian Wheat Workers Code of Ethics

This seed is being distributed (or received) in accordance with the "Canadian Wheat Workers' Code of Ethics," last revised by the Canadian Wheat Improvement Network on 25 February 2010.[†]

1. The originating breeder, institution or company has certain rights to the germplasm. These rights remain with the originator and are not waived with the distribution of seeds or plant material. A seed recipient is defined as an individual who directly contributes data for the trial in which the germplasm is being evaluated.

2. The recipient of seeds or plant material shall make no secondary distribution of the germplasm without the permission of the owner/breeder.

3. The owner/breeder, in distributing seed or other propagating material of the germplasm, grants permission for its use in trials under the recipient's control and as a male parent for making crosses from which selection will be made. As a courtesy, it is suggested that the owner/breeder be notified of the intent to use the germplasm in crosses.

4. Uses of all germplasm for which written approval of the owner/breeder is required include the following:
   a) Testing in regional trials or international nurseries.
   b) Use as a check in registration trials.
   c) Increase and release as a cultivar.
   d) Reselection from within the stock.
   e) Use as a parent of a commercial $F_1$ hybrid, synthetic, or multi-line cultivar.
   f) Use as a recurrent parent.
   g) Mutation breeding.
   h) Selection of somaclonal variants.
   i) Use as a recipient parent for asexual gene transfer, including gene transfer using molecular genetics techniques.

5. Germplasm distributed in public registration trials shall not be used for seed increase except for the purpose of creating a common seed source for further testing. Reasonable precautions to ensure retention or recovery of the germplasm shall be taken.

6. Germplasm with patented traits (e.g.: Clearfield® herbicide resistance) falls under these guidelines. When a line with a patented trait is used as a parent for crossing, active selection against the trait must be practiced. The consent to cross to germplasm with patented traits does not constitute any type of agreement with the owner of the trait.

7. The Canadian Wheat Workers' Code of Ethics does not apply to lines in private trials unless explicitly stated by the owner of the germplasm.

8. It is encouraged that a copy of this code accompanies any distributed germplasm to which it will apply. It is further suggested that the individual distributing the germplasm should sign and list the distributed material on the back of the copy. Signatures are not required for germplasm distributed in Canadian public registration trials.

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[†] Although this code was developed for lines entered into publicly run trials, it is hoped that the distribution of all germplasm will be done in a spirit of collaboration, as demonstrated herein. The Canadian Wheat Workers' Code of Ethics is based on a similar code developed by the National Wheat Improvement Committee of the USA.

## APPENDIX J. 2013-2014 PRCWRT MEMBERSHIP (APPROVED FEBRUARY 2013)

| Last Name | First Name | Title | Company/Institution | Committee position |
|---|---|---|---|---|
| Beres | Brian | Dr. | Agriculture & Agri-Food Canada | AET/ Chair |
| Pozniak | Curtis | Dr. | University of Saskatchewan | AET/Secretary |
| Aljarrah | Mazen | Dr. | Alberta Agriculture & Food | AET |
| Allison | Rhett | Mr. | Western Wheat Growers of Canada | AET |
| Bonis | Peter | Mr. | Seed Link | AET |
| Brûlé-Babel | Anita | Dr. | University of Manitoba | AET |
| Chapman | Bill | Mr. | Alberta Agriculture & Food | AET |
| Cuthbert | Patti | Dr. | Manitoba Agriculture, Food & Rural Initiatives | AET |
| Cuthbert | Richard | Dr. | Agriculture & Agri-Food Canada | AET |
| Davies | John | Dr. | Western Plant Breeders | AET |
| Degenhardt | Keith | Dr. | Western Grains Research Foundation | AET |
| DePauw | Ron | Dr. | Agriculture & Agri-Food Canada | AET |
| Durand | Claude | Mr. | Syngenta Seeds Canada | AET |
| Ferguson | Tim | Mr. | Viterra | AET |
| Fowler | Brian | Dr. | University of Saskatchewan | AET |
| Fox | Stephen | Dr. | Agriculture & Agri-Food Canada | AET |
| Goyal | Akash | Dr. | Bayer Crop Science | AET |
| Graf | Robert | Dr. | Agriculture & Agri-Food Canada | AET |
| Hawkins | Glen | Dr. | University of Alberta | AET |
| Holmstrom | Darrell | Mr. | Alberta Rye and Triticale Association | AET |
| Hucl | Pierre | Dr. | University of Saskatchewan | AET |
| Humphreys | Gavin | Dr. | Agriculture & Agri-Food Canada | AET |
| Huvenaars | Richard | Mr. | Alberta Soft Wheat Producers Commission | AET |
| Japp | Mitchell | Mr. | Saskatchewan Ministry of Agriculture | AET |
| Kirigwi | Francis | Dr. | Syngenta Seeds Canada | AET |
| Kubinec | Anastasia | Ms. | Manitoba Agriculture, Food & Rural Initiatives | AET |
| Larson | Jamie | Dr. | Agriculture & Agri-Food Canada | AET |
| Markert | Ron | Mr. | Candian Seed Growers Association | AET |
| Mercer | Lloyd | Mr. | Alberta Winter Wheat Producers Commission | AET |
| Meyer | Leo | Mr. | | AET |
| Moore | Martin | Mr. | B.C. Grain Producers Association | AET |
| Ntiamoah | Charles | Dr. | World Wide Wheat, LLC | AET |
| Ottmar | Philipp | Dr. | Plantomar LTD | AET |
| Procunier | James | Dr. | Agriculture & Agri-Food Canada | AET |
| Randhawa | Harpinder | Dr. | Agriculture & Agri-Food Canada | AET |
| Recksiedler | Blaine | Mr. | Saskatchewan Ministry of Agriculture | AET |
| Rourke | Dana | Ms. | Western Feed Grains Cooperative | AET |
| Rutherford | Rick | Mr. | Winter Cereals Canada | AET |
| Sajjad | Rao | Dr. | AgQuest Inc | AET |
| Singh | Danny | Dr. | Agriculture & Agri-Food Canada | AET |
| Spaner | Dean | Dr. | University of Alberta | AET |
| Tsai | Shaan | Mr. | Canterra Seeds Ltd. | AET |
| Woods | Bill | Mr. | CWB Director | AET |
| Comeau | André | Dr. | Agriculture & Agri-Food Canada | DET |
| DeRocquigny | Pam | Ms. | Manitoba Agriculture, Food & Rural Initiatives | DET |
| Despins | Therese | Ms. | Agriculture & Agri-Food Canada | DET |
| Fernandez | Myriam | Dr. | Agriculture & Agri-Food Canada | DET |
| Fetch | Tom | Dr. | Agriculture & Agri-Food Canada | DET |
| Foroud | Nora | Dr. | Agriculture & Agri-Food Canada | DET |
| Gaudet | Denis | Dr. | Agriculture & Agri-Food Canada | DET |
| Gilbert | Jeannie | Dr. | Agriculture & Agri-Food Canada | DET |
| Haber | Steve | Dr. | Agriculture & Agri-Food Canada | DET |

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|---|---|---|---|---|
| Hiebert | Colin | Dr. | Agriculture & Agri-Food Canada | DET |
| Khan | Jahangir | Dr. | AgQuest (Alta), Inc. | DET |
| Knox | Ron | Dr. | Agriculture & Agri-Food Canada | DET |
| Kutcher | Randy | Dr. | Crop Development Centre | DET |
| Martin | Richard | Dr. | Agriculture & Agri-Food Canada | DET |
| McCallum | Brent | Dr. | Agriculture & Agri-Food Canada | DET |
| McCartney | Curt | Dr. | Agriculture & Agri-Food Canada | DET |
| McLean | Eric | | Manitoba Seed Growers Association | DET |
| Menzies | James | Dr. | Agriculture & Agri-Food Canada | DET |
| Puchalski | Byron | Mr. | Agriculture & Agri-Food Canada | DET |
| Tekauz | Andy | Dr. | Agriculture & Agri-Food Canada | DET |
| Thomas | Julian | Dr. | Agriculture & Agri-Food Canada | DET |
| Turkington | Kelly | Dr. | Agriculture & Agri-Food Canada | DET |
| Xi | Kequan | Dr. | Alberta Agriculture & Food | DET |
| Arney | Sheilagh | Ms. | ADM Milling Co. | QET |
| Assefaw | Esay | Mr. | Canadian Grain Commission | QET |
| Beswitherick | Daryl | Mr | Canadian Grain Commission | QET |
| Briggs | Connie | Ms. | University of Saskatchewan | QET |
| Bushby | Pat | Mr. | Terminal Elevators Association | QET |
| Butti | Cathy | Ms. | Syngenta | QET |
| Dupuis | Brigitte | Dr. | Canadian Grain Commission | QET |
| Durand | Valerie | Ms. | Canada Bread Fresh Bakeries | QET |
| Dyck | Adam | Mr. | Warburtons | QET |
| Edwards | Nancy | Dr. | Canadian Grain Commission | QET |
| Entz | Peter | Mr. | Country Elevators Association | QET |
| Fernando | Dilantha | Dr. | University of Manitoba | QET |
| Hatcher | David | Dr. | Canadian Grain Commission | QET |
| Kieper | Richard | Mr. | Paterson Grain LTD | QET |
| Labach | Zane | Mr. | P & H Milling Group (Dover Mills) | QET |
| Lukow | Odean | Dr. | Agriculture & Agri-Food Canada | QET |
| McCaig | Tom | Dr. | Agriculture & Agri-Food Canada | QET |
| Nemeth | Lisa | Ms. | Canadian Wheat Board | QET |
| Niziol | Dave | Mr. | Agriculture & Agri-Food Canada | QET |
| Piercey | Stan | Mr. | Canada Bread Fresh Bakeries | QET |
| Santangelo | Paulo | Mr. | Ellison Milling Co. | QET |
| Sapirstein | Harry | Dr. | University of Manitoba | QET |
| Sarkar | Ashok | Mr. | Canadian Grain Commission | QET |
| Scanlon | Martin | Dr. | University of Manitoba | QET |
| Schlichting | Linda | Ms. | Canadian Grain Commission | QET |
| Sopiwnyk | Elaine | Ms. | Canadian International Grains Institute | QET |
| Woodbeck | Norm | Mr. | Canadian Grain Commission | QET |
| Worden | Graham | Mr. | Canadian Wheat Board | QET |
| Xiao | Bin | Dr. | Canadian International Grains Institute | QET |
| Bertholet | Jeff | Mr. | BASF Canada | AM |
| Downey | Jim | Mr. | SeCan Association | AM |
| Eamer | Brenda | Mrs. | Agriculture & Agri-Food Canada | AM |
| Gehl | David | Mr. | Agriculture & Agri-Food Canada | AM |
| Greig | Fred | Mr. | Canterra Seeds Ltd. | AM |
| Grenier | Mike | Mr. | Canadian Wheat Board | AM |
| Loiselle | Marc | Mr. | Saskatchewan Organic Directorate | AM |
| Nakonechny | Marvin | Mr. | Progressive Seeds | AM |
| Nelson | Ken | Mr. | KL Nelson Associates | AM |
| Nyachiro | Joseph | Dr. | Alberta Agriculture & Food | AM |
| Richardson | Sheldon | Mr. | World Wide Wheat LLC | AM |
| Smith | John | Mr | Seed Depot | AM |

| | | | | |
|---|---|---|---|---|
| Thompson | Wayne | Mr. | Western Grains Research Foundation | AM |
| Weik | Ron | Mr. | FP Genetics | AM |
| Wright | Brent | Mr. | ICMS Inc. | AM |