PRAIRIE RECOMMENDING COMMITTEE FOR OILSEEDS (PRCO)

APPENDIX C

Operating Procedures for the Registration of a Flax Cultivar for Production in Western Canada

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PRAIRIE RECOMMENDING COMMITTEE FOR OILSEEDS (PRCO)

APPENDIX C

Operating Procedures for the Registration of a Flax Cultivar for Production in Western Canada

C1. Background

There are two types of flax grown in western Canada brown and yellow linseed which have high linolenic acid oil used for industrial and edible purposes.

C2. The Prairie Recommending Committee for Oilseeds (PRCO)

The Prairie Recommending Committee for Oilseeds (PRCO) is the recommending body for registration of brown and yellow linseed. Recommendation for support of registration will be based on data from the Brown Linseed Flax Co-operative Trial, the Yellow Linseed Flax Co-operative Trial and the Northern Linseed Flax Co-operative Trial. To obtain this recommendation, the candidate cultivar must be evaluated in one of the Co-operative trials usually for a minimum of two (2) years and meet the minimum standards (*Sub-Appendix C4, Sub-Appendix C5* and *Sub-Appendix C6*) which demonstrate agronomic, quality and disease resistance acceptability and merit.

In order for a line to be evaluated in the Flax Co-operative trials, the sponsor of the candidate must obtain approval from the Flax Evaluation Committee. The Flax Evaluation Committee is made up of voting members of PRCO who are actively involved in the production, development and/or evaluation of potential flax cultivars for western Canada. Lines may be entered in the trial by Canadian public institutions or private breeding institutions, through a private sector Canadian sponsor or breeder's agent.

C3. The Co-operative Flax Trials

C3.1 Requirements for Entry into the Flax Co-operative Trials

A minimum of six (6) station-years of data collected from scientifically sound replicated field trials is required from locations in the major flax growing areas of Canada. The data must show that the potential candidate meets, at least, the minimum requirements for end-use suitability/ market place identification, disease reaction and agronomic performance as determined by its performance relative to appropriate check cultivars. Cultivars used as checks must include the designated check cultivars from the appropriate Co-operative Trial. Agronomic data in comparison to the appropriate check cultivars must include grain yield data from six (6) station-years; days to maturity, plant height, and 1000 seed weight from at least three (3) station-years; oil content and oil quality from at least two (2) station-years. Data is also required for reaction to rust and fusarium wilt and the testing procedure outlined in *Sub-Appendix C3* should be followed. (Testing for rust and fusarium wilt can be arranged by contacting the flax pathologist at Agriculture and Agri-Food Canada at the Morden Research Station; cost of such testing will follow cost recovery guidelines.)

Additional data for all of the above parameters may be useful especially when it becomes necessary to eliminate entries due to lack of space in the Trial. The maximum number of entries

is limited to 36 in the Brown Linseed Flax Co-operative Trial, the Yellow Linseed Flax Co-operative Trial and the Northern Linseed Flax Co-operative Trial. In the event that requests for entry exceed that total, the Flax Evaluation Committee will determine which entries will be included. The decision will be based on the merits of the potential entry relative to the appropriate check as determined by the data submitted for the entry and on an equitable and fair allocation of entry number. Requests for entry with the necessary supporting data must be supplied to the respective Trial Co-ordinator at least one (1) week prior to the annual meeting of the PRCO.

C3.2 Security of Entries

Breeding lines and non-released cultivars received from private or public sector plant breeders will be released only under conditions specified by the breeder or Canadian breeder agent. The professional code of ethics as developed by the Cultivar Registration Committee will be strictly followed by all individuals involved in the Co-operative testing and the cultivar registration process.

C3.3 Flax Co-operative Trial Procedure

C3.3.1 Trial Period

All candidates must be evaluated in the Co-operative Trial for two (2) years prior to consideration by the PRCO for support for registration.

C3.3.2 Trial Co-ordinator/Associate Trial Co-ordinator

The Co-ordinator of the Linseed Flax Co-operative Trial prepares lists of checks and candidate cultivars, experimental protocols and variables to be assessed (agronomic, quality and diseases) and verifies with owners of candidates. The Trial Co-ordinator organizes disease testing with the flax plant pathologist of Agriculture & Agri-Food Canada, prepares randomized designs, field books, packages seed for both agronomic testing and disease evaluation, distribution of packaged seed, harvest labels, electronic files, multiplication of seed of checks and candidates, receiving, cleaning, processing grain samples, measuring seed size, preparing subsamples and composites for oil content, fatty acid composition, and protein content, conducts quality evaluation, entering, analyzing, summarizing data on agronomic traits, writing and distributing the Co-operative Trial reports. Co-ordinators will be named for the Brown Linseed Flax Co-operative Trial, the Yellow Linseed Flax Co-operative Trial and the Northern Linseed Flax Co-operative Trial.

C3.3.3 Co-operator

The Co-operative trials are conducted at up to eleven (11) locations (*Sub-Appendix C1*) throughout the major flax growing areas of the prairies. Individual trial management is the responsibility of the co-operators, all trials are managed and harvested according to the standard and sound agronomic and scientific practices as appropriate for each site. At the present time, no “special management” practices can be performed for any candidate cultivar. If the need for special management of a cultivar candidate can be demonstrated by the sponsor, a new testing procedure may be developed.

C3.3.4 Data Collected

Seed yields are obtained at all sites. There will be a minimum of two replications per entry. Other information is collected where appropriate and feasible, including days to maturity, resistance to lodging, and plant height. Seed from each plot will be sent to the Trial Coordinator for determination of 1000 seed weight, seed colour, oil, fatty acid, iodine number and protein content. The quality determinations are carried out at the AAFC-Morden Research Station using

the methodology outlined in *Sub-Appendix C2*. Reaction to rust and fusarium wilt are determined by the plant pathologist at the AAFC-Morden Research Station following the procedures outlined in *Sub-Appendix C3*. Data from each co-operator must be sent to the Co-ordinator by November 15. We would prefer receiving the data in electronic form. All seed samples must be sent to the appropriate Co-operative Trial Co-ordinator by November 30. Data/seed sent after these deadlines may not be included in the Co-operative Trial Report.

C3.3.5 Check Cultivars

Check cultivars are included for agronomic, quality or disease resistance purposes, and normally include the best available registered cultivars for the main flax growing regions of western Canada. Check cultivars are determined annually by the Flax Evaluation Committee (see *Sub-Appendix C1* for current check cultivars).

C3.3.6 Experimental Design

A lattice design will be used, but a randomized complete block design may be employed if the number of entries does not allow for a lattice design. All yield and disease trials contain at least two replications. Yield trials vary from 3–8 rows, 3–6 m in length, with 23 or 30 cm row spacing. The entire plot or only the centre rows may be harvested; other modifications may be made as necessary at each location. The seeding rate used for brown linseed flax entries is equivalent to 40 lbs per acre adjusted for germination. All yellow linseed entries will use a seeding rate of 45 lbs per acre adjusted for germination. The appropriate coordinator is responsible for seed set-up, randomization and supplying field books to Co-operators.

C3.3.7 Continuation of Testing

Retention of entries for further testing is subject to approval by the Flax Evaluation Committee, especially in situations where space in the trial is limited. Judgment of merit of the entry for retention will be based on the data collected during the previous year(s) of the Linseed Flax Co-operative Registration trials.

C3.3.8 Seed Requirement

Six kg of untreated seed is required for first year entry into the trial. Seed for the second year of testing is produced annually in a common increase by the trial coordinator. The appropriate Trial Coordinator will annually multiply seed for the second year of the Brown Linseed Flax Co-operative Trial, the Yellow Linseed Flax Co-operative Trial and the Northern Linseed Flax Co-operative Trial. All seed entered in all trials, both first and second year entries, will be tested prior to seed setup for presence/absence of CDC Triffid by the sponsor. If an entry is shown to be contaminated (positive/present) to any level for the presence of CDC Triffid, the sponsor will be asked to replace the source of seed with a clean source of seed of the entry or provide an alternative entry which has shown to be uncontaminated. Additionally, a copy of the certificate will be provided to the co-ordinator(s) by the sponsor. The sponsor of an entry is advised to have on hand a 6 kg seed supply in case the Co-operative Trial increase is lost.

C3.3.9 Seed Treatment

Seed treatment will not be used. No treated seed will be accepted in the Brown Linseed Flax, Yellow Linseed Flax, or the Northern Linseed Flax Co-operative Trials.

C3.3.10 Trial Inspection

It is the intent of the Co-operative Trial Co-ordinator and/or other members of the Flax Workers group to inspect trials on an annual basis. A trial is considered non-valid if visual inspection by a Co-operator, or Trial Co-ordinator reveals unacceptable planting, emergence, soil gradient, pest or environmental problems. A trial is considered valid if the overall coefficient of variation for

yield is 15% or less; for C.V.'s over 15%, all agronomic and quality data will be eliminated for that location and year. Only in exceptional circumstances would this 15% guideline be waived.

C3.3.11 Fees

The Flax Evaluation Committee reserves the right to charge fees for the entry of candidate cultivars, in order to cover the cost of trial management and quality analysis and disease evaluation. Such fees will be negotiated with the sponsor when necessary.

C4. Submission of Data for Support of Registration

C4.1 Years and Checks

The data submitted for consideration for support for registration must include all the valid data from all the years in which the entry was included in the Flax Co-operative Trial. Candidate cultivars should be compared to the appropriate check variety within the co-operative trial entered. If possible, the check cultivar should have the same commercial application. During the years in the trial, an entry should be compared to the same check cultivar(s). That is, an entry in year 2 of the trial should be evaluated against the same check cultivar(s) against which it was evaluated in year 1.

C4.2 Relevant Data

All relevant data, including screening and laboratory data judged to be acceptable and useful by the PRCO, may be used in support of registration in addition to official trial data. Replicated, pre-Co-operative field data will be attached with the Co-operative data when soliciting support for variety registration. This pre-Co-operative data will be collected and reported in the same manner as the Flax Co-operative Trial report (*i.e.*, yield, maturity, height, etc.) and entries will be compared with the same check(s) as the Co-operative Trial. Agronomic data from trials outside the Canadian flax growing areas is not normally acceptable. When appropriate, market acceptability or pilot scale trial data are considered in support of registration; this may include letters of support from growers associations, provincial special crops or oilseeds committees, seed growers associations, contractors and buyers.

C4.3 Performance

To obtain support for registration, the minimum standard is overall performance of equal or better than the check cultivars with which the candidate has been compared during the two (2) years of testing (see *Sub-Appendix C4*, *Sub-Appendix C5* and *Sub-Appendix C6* for minimum standards). It is recognized that certain criteria are mandatory for certain regions or market classes and that minor deficiencies in certain parameters may be outweighed by advantages in others.

The principle of merit is used by the members of the PRCO in their decision regarding the support of a candidate for registration. The candidate cultivar must demonstrate merit when compared to the check and other registered cultivars. A candidate cultivar is considered superior if it is significantly higher yielding than the designated check cultivar for the Co-operative Trial (minimum standard). In addition, the candidate cultivar must be immune to rust and meet the minimum standards for oil content, oil quality and resistance to fusarium wilt as indicated by the designated check cultivars (see *Sub-Appendix C4*, *Sub-Appendix C5,* and *Sub-Appendix C6*). The candidate cultivar can be equal to the appropriate designated check cultivar in yield if the candidate is superior in oil content, oil quality, has earlier maturity or improved resistance to wilt and rust (new resistance gene or multigenic resistance), or other desirable attributes. A candidate has merit when, considering all traits including agronomic performance, disease resistance and end-use suitability, it has the potential to provide an advantage to the

producer or consumer in terms of production or marketing. The sponsor must demonstrate that the candidate cultivar has the desired end-use characteristics for its intended market class.

A candidate cultivar may be supported for registration based on performance advantage in a particular area of Canada and need not excel across the whole region. However, the decision to support a candidate cultivar for registration on a regional basis rests with the committee, and it is necessary for the sponsor to convince the committee of this "special" adaptation and that sufficient data exists over enough station-years to support the case.

C4.4 Deadline

An electronic or written summary of the data and the request for support for registration must be received by all members of the evaluation teams within the PRCO, specifically the Breeding, Agronomy & Production, Disease, and Quality & End-use evaluation teams, members of the Executive Committee of the PRCO and the Variety Registration Office, Plant Health and Production Division, Canadian Food Inspection Agency, 59 Camelot Drive, Ottawa, Ontario, K1A 0Y9 no later than the Monday, one (1) week prior to the annual meeting of the PRCO in February to be considered for support for registration.

C4.5 Registration Office

Once a candidate cultivar has been supported for registration, both the sponsor and the PRCO Secretary submit the data summaries, along with the copies of letters of support from the PRCO, to the Variety Registration Office, Field Crops Division, Canadian Food Inspection Agency, 59 Camelot Drive, Ottawa, Ontario, K1A 0Y9.

C5. Review of Guidelines

The guidelines shall be reviewed and amended where necessary at the discretion of the Flax Evaluation Committee at least once every five years. Amendments shall require the majority vote of the Flax Evaluation Committee. The check cultivars and locations in the Co-operative Trials and minimum standards for agronomic characters, oil content and quality and disease will be reviewed each year at the Prairie Recommending Committee for Oilseeds meeting.

C6. Specific Evaluations

Candidates entered and retained in the Flax Co-operative Trials will have sufficient merit compared to check cultivars to warrant their consumption of limited research resources. This co-operating group, the Trial Co-ordinator and the Associate Trial Co-ordinator, have a collective responsibility to manage the Linseed Flax Co-operative Trials to ensure unbiased and accurate testing of candidates.

SUB-APPENDIX C1 - Agronomic Evaluation for the Linseed Flax Co-operative Trials

I. Brown Linseed Flax Co-operative Trial

A. Co-ordinator:

Dr. Scott D. Duguid
Agriculture and Agri-Food Canada
Morden Research Station
Unit 100 - 101 Route 100
Morden, Manitoba R6M 1Y5
Tel: (204) 822-7232
Fax: (204) 822-7207
Email: scott.duguid@agr.gc.ca

B. Check Cultivars:

Flax - Flanders, CDC Bethune

C. Trial Sites:

1. **Co-operative Trial**
   Zone 1- Black & Grey Soil Zones (Longer Growing Season)
   Manitoba – Morden AAFC, Brandon South AAFC
   Saskatchewan – Indian Head AAFC

   Zone 2 - Brown Soil Zone
   Saskatchewan – Regina AAFC, Strasbourg VT, Moose Jaw VT, Saskatoon U of S, Floral U of S

   Zone 3 - Black and Grey Soil Zone (Shorter Growing Season)
   Saskatchewan – Lake Lenore VT, Melfort U of S
   Alberta – Vegreville VT

D. Measurement and Rating Scale:

Yield - Yield at each station will be calculated and expressed in three ways:
1. >00 kg/ha
2. % of CDC Bethune
3. rank of entries calculated

Maturity - days from time of seeding to 75% brown boll stage

Height of main stem - cm

Lodging: 1–9 (1 = no lodging; 9 = completely lodged)

Seed weight - g/1000 seeds

E. Sites for measurement of:

Yield and Maturity:	All sites.
Height and Seed Weight:	Two (2) sites from Zone 1 (Morden, Brandon South), two (2) sites from Zone 2 (Strasbourg, Saskatoon), two (2) sites from Zone 3 (Melfort, Vegreville).
Lodging:	All sites reporting significant lodging.

Where a location has a C.V. for yield over 15%, height and seed weight analysis will not be conducted on that location but an alternate location from that particular zone will be chosen and reported in the Brown Linseed Flax Co-operative Trial Report.

II. Yellow Linseed Flax Co-operative Trial

A. Co-ordinator:

Dr. Helen Booker
Crop Development Centre
University of Saskatchewan
51 Campus Drive
Saskatoon, Saskatchewan
S7N 5A8
Tel: (306) 966-5878
Fax: (306) 966-5015
Email: helen.booker@usask.ca

B. Check Cultivars:

Flax – CDC Bethune, Flanders

C. Trial Sites:

1. **Co-operative Trial**
   Zone 1- Black & Grey Soil Zones (Longer Growing Season)
   Manitoba – Morden AAFC, Brandon South AAFC
   Saskatchewan – Indian Head AAFC

   Zone 2 - Brown Soil Zone
   Saskatchewan – Regina AAFC, Strasbourg VT, Moose Jaw VT, Saskatoon U of S, Floral U of S

   Zone 3 - Black and Grey Soil Zone (Shorter Growing Season)
   Saskatchewan – Lake Lenore VT, Melfort U of S
   Alberta – Vegreville VT

D. Measurement and Rating Scale:

Yield - Yield at each station will be calculated and expressed in three ways:

1. >00 kg/ha
2. % of CDC Bethune
3. rank of entries calculated

Maturity - days from time of seeding to 75% brown boll stage

Height of main stem - cm

Lodging: 1–9 (1 = no lodging; 9 = completely lodged)

Seed weight - g/1000 seeds

E. Sites for measurement of:

Yield and Maturity:	All sites.
Height and Seed Weight:	Two (2) sites from Zone 1 (Morden, Brandon South), two (2) sites from Zone 2 (Strasbourg, Saskatoon), two (2) sites from Zone 3 (Melfort, Vegreville).
Lodging:	All sites reporting significant lodging.

Where a location has a C.V. for yield over 15%, height and seed weight analysis will not be conducted on that location but an alternate location from that particular zone will be chosen and reported in the Yellow Linseed Flax Co-operative Trial Report.

III. Northern Linseed Flax Co-operative Trial

A. Co-ordinator:

Dr. J.C. Paul Dribnenki
Viterra
AITF Facility
Highway 16A and 75th Street
Vegreville, AB T9C 1T4
Tel: (780) 632-8224
Fax: (780) 632-8612
Email: paul.dribnenki@viterra.ca

B. Check Cultivars:

Flax - Flanders, CDC Bethune, Prairie Grande

C. Potential Trial Sites (early discussions with MAFRI & BCGPA):

1. Co-operative Trial

Manitoba – Arborg (MAFRI) and Roblin (MAFRI)

Saskatchewan – Glaslyn (AAFC), Saskatoon, SK (U of S), Lake Lenore (VT) and Melfort (U of S)

Alberta – Lacombe (AAFC) and Vegreville (VT)

British Columbia – Dawson Creek (BCGPA)

D. Measurement and Rating Scale:

Yield - Yield at each station will be calculated and expressed in three ways:

1. >00 kg/ha
2. % of CDC Bethune
3. rank of entries calculated

Maturity - days from time of seeding to 75% brown boll stage

Height of main stem - cm

Lodging: 1–9 (1 = no lodging; 9 = completely lodged)

Seed weight - g/1000 seeds

E. Sites for measurement of:

Yield and Maturity:	All sites.
Height and Seed Weight:	Two (2) sites from Manitoba (Arborg and Roblin), two (2) sites from Saskatchewan (Glaslyn, Melfort), two (2) sites from Alberta (Lacombe, Vegreville) and one site from British Columbia (Fort St. John).
Lodging:	All sites reporting significant lodging.

Where a location has a C.V. for yield over 15%, height and seed weight analysis will not be conducted on that location but an alternate location will be chosen and reported in the Northern Linseed Co-operative Trial Report.

SUB-APPENDIX C2 - Quality Evaluation for the Linseed Flax Co-operative Trials

Oil Content:	NI Oil Content is determined by near infrared measurements calibrated against the NMR extraction reference method. Results are reported as percent, calculated to a moisture-free basis.
Fatty Acid Composition:	Determined by gas liquid chromatography of the fatty acid esters according to the AOCS Ce-91 method with esters prepared by the AOCS Ce 2-66(93) method.
Alpha Linolenic Acid	Determined by gas liquid chromatography of the fatty acid esters according to the AOCS Ce-91 method with esters prepared by the AOCS Ce 2-66(93) method.
Iodine Number:	Calculated from fatty acid composition according to AOCS Cd 1c-85 or NIR.
Oil-Free Protein Content:	NI Protein Content is determined by NIR on the seed, NIR calibrated against the Combustion Nitrogen Analysis Reference Method and is expressed on an N x 6.25, whole seed dry basis and on an oil-free meal basis.

For oil content, fatty acid composition, iodine number and protein content determinations, individual plots are used.

I. Brown Linseed Flax Co-operative Trial

Sites for measurement of Oil Content, Fatty Acid Composition, Alpha Linolenic Acid, Iodine Number and Protein Content of the Seed and the Meal:

> Up to three (3) sites from Zone 1 (Morden, Brandon South, Indian Head), three (3) sites from Zone 2 (Regina, Strasbourg, Saskatoon), and three (3) sites from Zone 3 (Lake Lenore, Melfort, Vegreville).

Where a location has a C.V. for yield over 15%, oil content, fatty acid analysis, alpha linolenic acid content, iodine number and protein content will not be conducted on that location but an alternate location from that particular zone will be chosen and reported in the Co-op Report.

II. Yellow Linseed Flax Co-operative Trial

Sites for measurement of Oil Content, Fatty Acid Composition, Alpha Linolenic Acid, Iodine Number and Protein Content of the Seed and the Meal:

> Up to three (3) sites from Zone 1 (Morden, Brandon South, Indian Head), three (3) sites from Zone 2 (Regina, Strasbourg, Saskatoon), and three (3) sites from Zone 3 (Lake Lenore, Melfort, Vegreville).

Where a location has a C.V. for yield over 15%, oil content, fatty acid analysis, alpha linolenic acid, iodine number and protein content will not be conducted on that location but an alternate location from that particular zone will be chosen and reported in the Co-op Report.

III. Northern Linseed Flax Co-operative Trial

Sites for measurement of Oil Content, Fatty Acid Composition, Alpha Linolenic Acid, Iodine Number and Protein Content of the Seed and the Meal:

All nine (9) sites.

In case of failure of Flanders check cultivar (maturity) in the trial then the check cultivar Prairie Grande will be utilized as the minimum standard check cultivar.

Where a location has a C.V. for yield over 15%, oil content, fatty acid analysis, alpha linolenic acid, iodine number and protein content will not be conducted on that location.

SUB-APPENDIX C3 - Disease Evaluation of the Linseed Flax Co-operative Trials

Procedures for Rust Evaluation

Experimental lines are evaluated for rust reaction, in comparison to standard cultivars, at the seedling stage under controlled growth room conditions of 16 hr photoperiod and day night temperature of 22°/18°C. A total of 300 to 400 2–week old seedlings from each entry are artificially inoculated with the local rust race 371 using 1 g/L of spore suspension in a light petroleum oil (Soltrol 170). The inoculated seedlings are incubated under conditions of high relative humidity for 18 hr and then uncovered and left in the same growth room. Scoring is done ten (10) days after inoculation using the infection type reactions (IT) as follows:

0 = No sign of infection	Immune
; = Fleck, hypersensitive reaction	Highly Resistant
1 = Very small pustule <0.5 mm in diameter.	Resistant
2 = Small pustule 0.5-<1.0 mm in diameter.	Moderately Resistant
3 = Pustule of 1.0-1.5 mm in diameter	Susceptible
4 = Large pustule > 1.5 mm in diameter	Susceptible

Seedlings are classified into three categories: immune (IT 0 & ;), resistant (IT 1 & 2) and susceptible (IT 3 & 4). The percentages of each category in experimental entries segregating for rust reaction are calculated and reported.

The minimum requirement for rust reaction, to support the recommendation for registration of candidate cultivars, is immune reaction (immune or hypersensitive with up to 2% resistant reaction) to the most recent predominant local race(s) of rust.

Procedures for Fusarium Wilt Evaluation

Experimental lines are evaluated for their reaction to fusarium wilt, in comparison to standard cultivars, in wilt infested field nurseries located at the Research Centre in Morden and at the Experimental Farm in Indian Head. The entries are planted in 2-row plots in a randomized complete block design with at least three (3) replicates. Rows are 2.5 m long and 0.3 m apart. The susceptible cultivar Novelty is planted after every six (6) rows to indicate the level of disease and uniformity of inoculum in the soil. Planting is usually done during the last week of May to the first week of June.

Scoring for wilt reaction is based on a combination of wilt symptoms and plant vigour assessments which include discoloration of leaves, reduction in height, reduction in branching, percentage of severely infected and dead plants using a scale of 0 to 9 as follows:

0 = No sign of wilt, the most vigorous.
1 = Vigorous, yellowing on 0–5% of the leaves.
2 = Vigorous, yellowing on 5–10% of leaves.
3 = Slight reduction in vigour, yellowing on 10–20% of leaves, slight reduction in height or branching. No severely wilted or dead plants.
4 = Moderate vigour, yellowing on 20–40% of leaves, moderate reduction in height or branching and/or <1% severely wilted or dead plants.

5 = Moderate vigour, yellowing on 40–60% of leaves, moderate reduction in height or branching and/or 1–10% severely wilted or dead plants.
6 = Poor vigour, yellowing on >60% of leaves, moderate reduction in height or branching and/or 10–30% severely wilted or dead plants.
7 = Poor vigour, yellowing, severe reduction in height or branching and/or 30–60% severely wilted or dead plants.
8 = Very poor vigour, severe reduction in height or branching and/or 60–90% severely wilted or dead plants.
9 = All plants severely wilted or dead.

This assessment is carried out three (3) times during the growing season; at the seedling stage 5 to 6 weeks after planting (early July), at the early flowering stage (end of July), and at the green boll stage (mid August). The reactions of the entries to fusarium wilt are summarized as mean values of the three scores of the four (4) replicates at both locations. The mean values of reactions to fusarium wilt in current year of testing and the preceding year are presented. The 2-year means are also calculated and the final evaluation of the experimental lines is based on their performance in the two (2) years as well as the 2-year means in comparison with the check cultivars. In addition to the check cultivars indicated in *Sub-Appendix C1*, AC Emerson will also be included in the wilt tests.

The minimum standard requirement for fusarium wilt reaction, to support the recommendation for registration of cultivars from the Brown Linseed Flax, the Yellow Linseed Flax and the Northern Linseed Flax Co-operative Trials is a moderately resistant reaction. The mean of the wilt reactions of the cultivars NorLin and Flanders represents the minimum standard for Brown Linseed Flax cultivars whereas the minimum standard for wilt reaction for Yellow Linseed Flax cultivars is Linola™ 2047. However, the breeders and the pathologist are establishing a breeding intention for a new level of fusarium wilt resistance in brown (NorLin) and yellow linseed flax cultivars (mean of Flanders and Linola™ 2047) that will be shown in the annual disease report, which is part of the overall Co-operative Trial report.

Other Diseases

Powdery Mildew: This disease has been widespread in western Canada since it was first observed in 1997. Some flax cultivars have demonstrated a good level of resistance to this disease and the breeders are encouraged to incorporate and strive to maintain resistance to powdery mildew in new flax varieties. It is suggested that minimum standards of resistant reaction be established recommending brown and yellow linseed flax cultivars for registration in the future following further analysis and study and that the issue of minimum standard be reviewed on annual basis. To this end the breeders and pathologist will establish a breeding intention for a level of resistance to powdery mildew for both brown (Flanders) and yellow (Flanders) linseed flax cultivars that will be shown in the annual disease report, which is part of the overall Co-operative Trial report.

Pasmo: This disease is the most prevalent disease on flax in western Canada. Present flax cultivars are susceptible to this disease. No minimum standards can be established for this disease until reliable sources of resistance/tolerance are identified and become available to the breeding programs. To this end the breeders and pathologist will establish a breeding intention for a level of resistance to pasmo for both brown and yellow linseed flax cultivars (Macbeth) that will be shown in the annual disease report, which is part of the overall Co-operative Trial report.

Other diseases including stem break/browning, anthracnose, alternaria blight, basal stem blight, aster yellows and root rot/seedling blight are of minor importance and there are no guidelines or standard requirements for these diseases in the evaluation of candidate cultivars.

SUB-APPENDIX C4 - Minimum Standards for Brown Linseed Flax Cultivar Registration – 2011

Agronomic

Yield – Statistically not significantly less than the check cultivar CDC Bethune.

Maturity – Statistically not significantly later than Flanders.

Seed weight – Statistically not significantly lower than Flanders.

Lodging resistance – Statistically not significantly higher than Flanders for entries intended for production in Manitoba.

Quality

Oil content – Statistically not significantly lower than the check cultivar of Flanders.

Oil quality (iodine number) – Statistically not significantly lower than Flanders.

Oil quality (alpha-linolenic acid) – Statistically not significantly lower than Flanders.

Oil-free protein content – Statistically not significantly lower than Flanders.

Seed coat color – Brown.

Disease resistance

Rust – Immune, with up to 2% resistant, to race 371.

Fusarium wilt – Moderate resistance, statistically not significantly lower than the mean of the check cultivars Flanders and NorLin.

SUB-APPENDIX C5 - Minimum Standards for Yellow Linseed Flax Cultivar Registration – 2011

Agronomic

Yield – Statistically not significantly less than the check cultivar CDC Bethune.

Maturity – Statistically not significantly later than Flanders.

Seed weight – Statistically not significantly lower than Flanders.

Lodging resistance – Statistically not significantly higher than Flanders for entries intended for production in Manitoba.

Quality

Oil content – Statistically not significantly lower than the check cultivar of Flanders.

Oil quality (iodine number) – Statistically not significantly lower than Flanders.

Oil quality (alpha-linolenic acid) – Statistically not significantly lower than Flanders.

Oil-free protein content – Statistically not significantly lower than Flanders.

Seed coat color – Yellow.

Disease resistance

Rust – Immune, with up to 2% resistant, to race 371.

Fusarium wilt – Statistically not significantly lower than the mean of the check cultivar Linola™ 2047.

SUB-APPENDIX C6 - Minimum Standards for Northern Linseed Flax Cultivar Registration – 2011

Agronomic

Yield – Statistically not significantly less than the check cultivar CDC Bethune.

Maturity – Statistically not significantly later than Prairie Grande.

Seed weight – Statistically not significantly lower than Flanders.

Lodging resistance – Statistically not significantly higher than Flanders for entries intended for production in Manitoba.

Quality

Oil content – Statistically not significantly lower than the check cultivar of Flanders.

Oil quality (iodine number) – Statistically not significantly lower than Flanders.

Oil quality (alpha-linolenic acid) – Statistically not significantly lower than Flanders.

Oil-free protein content – Statistically not significantly lower than Flanders.

Seed coat color – Brown or yellow.

Disease resistance

Rust – Immune, with up to 2% resistant, to race 371.

Fusarium wilt – Moderate resistance, statistically not significantly lower than the mean of the check cultivars Flanders and NorLin for brown entries and Linola™ 2047 for yellow entries.