

Operations Manual

Canadian Journal of Plant Science
Canadian Journal of Soil Science
Canadian Journal of Animal Science

(Revised 2007)

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PART I. EDITORIAL/REVIEW PROCEDURES

A. HISTORY OF THE AGRICULTURAL INSTITUTE OF CANADA JOURNALS

In 1920 the Canadian Society for Technical Agriculture (CSTA) was formed. The organizing committee considered the possibility of a society publication and, after unsuccessfully approaching the Department of Agriculture for financial assistance, an agreement was reached with the Industrial Education Publishing Company to produce the journal. Editorial control was maintained by CSTA and on 28 January 1921 the first issue of *Scientific Agriculture/La Revue Agronomique Canadienne* appeared. By the end of May, four more issues had been published but in July 1921 the publishing company informed CSTA that due to limited advertising and the overall number of subscribers it could no longer produce the journal. The society took over publication and by 1922 the journal was showing a small profit.

For the next 11 years the journal was a combined society magazine and technical publication published six times a year. Financing continued to be a problem and in 1934 the Department of Agriculture assumed financial responsibility for publication with the society continuing to control editorial policy.

In 1953 the journal was renamed *Canadian Journal of Agricultural Science* and its frequency of publication was increased to 12 issues a year. Editorial responsibility was broadened to include an editorial board rather than just the editor.

With an increasing number of pages came a desire for specialization. Effective 1 January 1957 the journal was split into three: *Canadian Journal of Plant Science*, *Canadian Journal of Soil Science* and *Canadian Journal of Animal Science*. The Department of Agriculture continued to publish the journals until 1966 when the society once again took over, but government funding continued; page charges were instituted and authors were charged for reprints.

The number of pages continued to grow and in order to avoid publication delays it became necessary to increase the number of issues. In 1964 *CJPS* was increased to six issues a year, and *CJSS* and *CJAS* to three issues a year. In 1973 the frequency of the three journals was changed to its present quarterly publication. In 1994 the page size of the journals was changed to 8.5 × 11 inches to reflect modern publishing formats.

Today the journals publish some 2300 pages annually. They are read in more than 100 countries and have close to 3500 subscribers.

B. TERMS OF REFERENCE

Overall responsibility for the three journals is shared between the Scientific Journals Committee (SJC), and the Agricultural Institute of Canada (AIC). The SJC has overall responsibility for any matters concerning the editorial content, style, standards and review policy of the journals. It meets for at least one day each year during which it will

review budgets and financial forecasts, including subscription and page-charge rates. The SJC also reviews matters referred by the Editorial Committees of the three Journals and makes recommendations to the AIC Board and Executive Director. Matters affecting the financial standing of the journals must be referred to the Executive Director. Each journal is sponsored by and is the official publication of one or more scientific societies, each of which is an associate member of the AIC. These are:

Canadian Journal of Plant Science
Canadian Society of Agronomy (CSA)
Canadian Society for Horticultural Science (CSHS)
Canadian Weed Science Society
Canadian Journal of Soil Science
Canadian Society of Soil Science (CSSS)
Canadian Journal of Animal Science
Canadian Society of Animal Science (CSAS)

1. Scientific Journals Committee

Function and Duties

The Scientific Journals Committee is responsible for the general publication policy of the three scientific journals. The committee reviews budget estimates as prepared by AIC staff and makes recommendations for the consideration of the AIC Board and Executive Director.

Composition and Tenure

The committee consists of:

- (a) Chair (1-year term), who is the most recently retired journal Editor.
- (b) Editors of the three journals (3-year term).

Composition

The Scientific Journals Committee consists of at least nine members plus the Chair. Replacement members are nominated by the current respective Editors with the cooperation of the appropriate affiliated scientific societies. Nominees are ratified by vote of the SJC. The Chair of the SJC must be a member of a sponsoring scientific society. The SJC consists of:

- (a) Three members representing the Canadian Society of Animal Science for the *Canadian Journal of Animal Science*, one of whom is the Editor and the other two Associate Editors.
- (b) Three members representing the Canadian Society of Soil Science for the *Canadian Journal of Soil Science*, one of whom is the Editor and the other two Associate Editors.
- (c) Three members representing the Canadian Society of Agronomy, the Canadian Society for Horticultural Science and the Canadian Weed Science Society for the *Canadian Journal of Plant Science*. Of the three members, one is the Editor and the other two are Associate Editors.
- (e) The Head, Journals Section is an ex-officio member of the SJC.

The SJC may nominate such additional members as may be required. If a member is absent from a meeting of the SJC

a motion shall be called at the beginning of the meeting nominating a replacement member from the Associate Editors of the absent member's journal. The replacement member shall sit as a SJC member with full voting rights until the return of the absent member.

Tenure

Members of the Scientific Journals Committee are normally elected from the present or past Associate Editors who have served at least 1 year. The term of SJC members is 2 years. However, members may serve successive terms. Members are elected to serve 2 years or the unexpired term of the incumbent they replace. The terms of all positions on the SJC may be adjusted by the SJC to meet its requirements. An Editor, Associate Editor or Assistant Editor who is not adequately carrying out his or her duties may be relieved of responsibility by the SJC.

Voting

- (a) Meetings are conducted according to *Robert's Rules of Order* in which the Chair does not normally vote, but may do so to break a tie.
- (b) Voting is normally by show of hands. However, any member may call for a secret ballot, subject to the approval of the Board.
- (c) The Head, Journals Section does not vote on the SJC.

2. Associate Editors

Function

Associate Editors are appointed by the SJC to review and (for *CJPS* and *CJSS*) determine acceptance or recommend to the Editor rejection, or (for *CJAS*) to accept or reject papers.

Composition and Tenure

Associate Editors are appointed to function for the respective journals from nomination of scientific societies. Associate Editors are appointed for a term of 3 years or to fill the unexpired portion of a previous incumbent's 3-year term. Associate Editors may normally serve two successive 3-year terms.

3. Editorial Committees

Each of the journals has an Editorial Committee composed of the respective Editor as Chair and all Associate Editors, including SJC representatives, as members. The function of the committees is to represent journal and society concerns and to see that appropriate action is taken through the representatives on SJC. All SJC members (including Editors) should maintain communications with the societies they represent, through procedures devised by the societies, so that concerns of all parties may be suitably addressed.

C. PUBLICATIONS OFFICE

The Publications Office, located at the AIC national office, is responsible for technical editing and production from receipt of accepted papers to publication and distribution. The office comprises the Head, Journals Section, the Publishing Assistant and the Subscriptions Officer. The

Head, Journals Section sits as an ex-officio, non-voting member of the Scientific Journals Committee and PSC and acts as secretary to both bodies.

Duties include obtaining quotations from typesetters and printers and negotiating prices for final approval by the SJC; preparing budgets and financial forecasts and advising on page charges and subscription rates for approval by the SJC; centralized manuscript tracking; logging and acknowledging receipt of accepted manuscripts from Associate Editors; copy-editing manuscripts for style, accuracy and consistency, marking copy for typesetters; sizing artwork; monitoring flow of proofs to and from authors; coordinating the work of freelance proofreaders; checking page proofs and passing blues for press; invoicing authors for page charges and reprints; maintaining all subscription records and invoicing subscribers for payment.

Scheduling of Papers

Papers accepted by Associate Editors are sent to the publication office for processing. On receipt of a manuscript, the publication office informs the corresponding author of the manuscript's acceptance and the issue for which it has been scheduled. The author may also be asked to supply original artwork, key words or short titles if these have not been included. If these are not received by the "copy date", the manuscript will be re-scheduled to the next issue.

All correspondence concerning accepted papers in press, reprints, page charges and subscriptions should be addressed to:

Journals Section
Agricultural Institute of Canada
Suite 900, 280 Albert St.
Ottawa, Ontario, Canada K1P 5G8
E-mail: journals@aic.ca
Tel. (613) 232 9459
Fax. (613) 594 5190

D. SUBMISSION OF MANUSCRIPTS

All manuscripts must be submitted via the OSPREY Online Manuscript Submission and Peer Review system, available through the AIC web site (www.aic.ca).

When reference is made to manuscripts that are "in press", an electronic version of the in-press paper should also be submitted.

Membership in the journals' sponsoring scientific societies or the Agricultural Institute of Canada is not a requirement for publishing in the journals.

Manuscripts submitted to the journals must not have been concurrently submitted to other journals. Manuscripts may be submitted in English or French. All authors of manuscripts submitted to Canadian Journal of Plant Science, Canadian Journal of Animal Science, and Canadian Journal of Soil Science must sign a manuscript submission form to indicate that they have reviewed the manuscript and support its publication.

Authors submitting to Canadian Journal of Plant Science must submit the names of three potential reviewers (please provide address, telephone and fax numbers and e-mail address).

Manuscripts are subject to peer review and acceptance or rejection. Acceptance may be conditional on satisfactory revision. Publication of accepted manuscripts is conditional on the full payment of page charges and any other costs by the author(s).

1. Content

Papers submitted to the journals should contain new information of national or international significance. Review papers may be submitted by invitation of one of the sponsoring societies or with permission of the Editor (see the section on Review papers, page 5). Letters to the Editor may explain, amplify or otherwise comment on research published in the journals. Before submitting papers, authors should have one or two colleagues critically review the paper.

Authors submitting papers to the *Canadian Journal of Animal Science* must state that experimental animals were cared for under guidelines equivalent to those of the Canadian Council on Animal Care in its *Guide to the Care and Use of Experimental Animals* (Canadian Council on Animal Care, 315-350 Albert Street, Ottawa Ontario, Canada K1R 1B1, Tel.: (613) 238-4031, Fax: (613) 238-2837, E-mail: ggriffin@bart.ccac.ca, Website: www.ccac.ca).

2. Prior Publication

Manuscripts submitted to the journals must not have been concurrently submitted to, or accepted by, any other publication nor published in full or in part in any other refereed publication nor posted on Internet websites, either personal or institutional. Authors should declare any possible conflict with this policy when they submit papers.

3. Copyright

Authors, or their employers in the case of work carried out under contract or terms of employment, own the copyright on their work. Permission to reprint or reproduce contributions or parts of contributions must therefore be obtained from authors or their employers, not from the Agricultural Institute of Canada. However, the AIC requests that credit be given by quoting the journal title, volume and page numbers.

The Canadian Government owns copyright on work carried out by authors while in its employ. Copyright permission may be obtained from the Public Works of Supply and Services Canada, Ottawa, Ontario.

Permission to reproduce material from other published sources in the journals should be obtained by the author. Letters granting permission should be included with manuscripts when submitted.

The journals are registered with the Copyright Clearance Center (CCC) which permits limited photocopying of published material providing a small fee is paid to the CCC (222 Rosewood Drive, Danvers, MA 01923, USA, Website: <http://www.copyright.com/>). Details of this service may be found on the inside front cover of any issue of the journals.

4. Review Process when an Editor Submits a Manuscript

When the Editor of one of the journals submits a manuscript to the journal of which he/she is the Editor, an "Acting Editor" will be chosen to act as Editor. The Acting Editor may be a past Editor of the journal, a current senior Associate Editor or a Special Issues Editor. The Acting Editor will be assigned by the Editorial Office (AIC).

The Acting Editor will assign the manuscript to one of the journals' Associate Editors, who will select reviewers in the usual way. In all cases, whether the manuscript is accepted or rejected, the Associate Editor will communicate with the Acting Editor concerning the reviews and resulting recommendation; the Acting Editor will in turn communicate with the Editor. The Associate Editor may not communicate directly with the Editor. The Acting Editor will take appropriate steps to ensure that the Associate Editor and reviewers remain anonymous to the Editor.

Manuscripts must be submitted via the OSPREY online system, and the Acting Editor will be given the "role" of Editor, with access only to those papers he/she has been assigned. The Editor will not have access to data on the manuscript assigned to the Acting Editor.

PART II. STYLE GUIDE

A. CONTENTS

1. Papers

Papers can be submitted in the fields of animal, plant and soil sciences if they contain new information of national or international interest and application. Submission of a manuscript implies that it is based on research not previously published. All authors must be aware of and agree to the data presented and conclusions drawn in a manuscript.

2. Short Communications

Short communications are open to short preliminary reports of important findings. They might contain research results that are complete but characterized by a rather limited area or scope of investigation, description of new cultivars (see page 10), descriptions of new or improved techniques or equipment including data on performance. Short communications should contain only a few (usually not more than nine) references. Illustrative material should be kept to a minimum, usually not more than two tables or figures. Short communications should not generally exceed 2000 words. Abstracts are obligatory and shall be no longer than 100 words.

3. Letters to the Editor

Letters commenting on published papers are accepted. The author(s) of the paper being commented on are given the opportunity to reply in the same issue as the one in which the comment appears. Letters must be signed and should be sent to the Editor. The full page charge is payable by the author of the letter on publication.

4. News and Notes

This section is available to the sponsoring scientific societies to publish information of interest. The publishing society will be charged the full page charge.

5. Guidelines for Publication of Symposia Papers

The three journals are available as outlets for affiliated society symposia papers. Normally, no more than one set of symposium papers per journal will be accepted annually and the papers published will be footnoted to indicate presentation as part of a symposium. (For example: Presented at the Canadian Society of Animal Science (Western Branch) Symposium entitled "Production Potential of the Livestock Industry: Have Genetic Limits been Reached?" 14 June 1983, Saskatoon, Saskatchewan.)

Current page charges will apply to symposia papers and, therefore, will be the responsibility of the author(s). Papers presented at symposium sessions need not be published in the respective journal. However, the affiliated society should decide whether or not it expects to publish before inviting participants. If publication is intended, participants should be selected accordingly and be advised to participate. If the intention is to publish symposium proceedings, the sponsoring affiliated society should appoint an ad hoc

Symposium Program Committee. It is the responsibility of that committee (a) to select suitable participants; (b) to advise participants of the form and style the manuscript must follow; (c) to inform participants that the manuscript must be received by the time of the symposium; (d) to forward manuscripts to the Publications Office for review; and (e) to recommend special acting Associate Editors to handle these manuscripts. The two months subsequent to the symposium will be allowed for editing and revision by the author.

There should be a maximum of 25 double-spaced type-written line-numbered pages (approximately 250 words per page) for each manuscript. Usually, tables and figures should total no more than five in number and references should be those only highly pertinent to the topic (usually, no more than 30 in number). The usefulness, accuracy, style and scientific content of the paper will be reviewed by the normal editorial process, and the question of manuscript suitability and rejection should rarely arise if adequate care is taken. The Symposium Committee must ensure, therefore, that the manuscript is of sufficient merit to maintain the high standard of the journal and the interest of its readers.

The Symposium Program Committee should work closely with the Editor of the journal to assure that format and style conform to journal policy.

6. Review Papers

Review articles will be considered for publication, but authors must seek permission from the Editor prior to submission. Review manuscripts may require more time for review than regular papers or short communications. Manuscripts of review papers covering topics recommended by a sponsoring society are handled in the same way as other manuscripts, i.e., are subjected to peer review, revision if needed, and/or rejection if the manuscript is unsatisfactory. They must summarize, analyze, integrate and interpret current information and propose new avenues of research. The authors are responsible for payment of page charges.

B. STRUCTURE OF PAPERS

1. Title

The title of the paper should be brief but should reflect all aspects of the work published. Generally, titles should be indicative rather than informative, i.e., they should state the subject of the paper rather than its conclusions but should identify the main topics of the paper. Titles may be used by abstracting companies and indexing services for information retrieval. Avoid the use of superfluous words such as "effect of", etc. Serial titles are generally discouraged.

Include the name of the organism used if appropriate. Use the common names of plants except for little-known species and weeds. Papers in the series "Biology of Canadian Weeds" must include the scientific name of the weed(s) under discussion and the authority. (Papers in this series are numbered; numbers will be assigned by the Publications

Office.) Titles of cultivar descriptions must include the cultivar name and common name, e.g., “Encore faba bean”.

Titles are set in upper and lower case.

2. By-line

The by-line consists of the name(s) of the author(s) and their addresses (use the address of the institution where the research was carried out). Names and addresses are set on separate lines. Following the addresses and continuous with them are contribution numbers (if any) and received and accepted dates (day, month, year). Either the full given name or initials may be used but use of the full name will prevent confusion in future citation. Do not include academic degrees or professional titles. The e-mail address of the corresponding author should be supplied. When a paper has several authors from different institutions, key the author to the address with superscript arabic numerals. (The numeral should follow the author’s name and precede the address.)

When addresses are given in a language other than English or French, do not translate them but use the English name of the country and city. Canadian and American addresses should be spelled out in full in the first citation only and abbreviated on second and subsequent citations; include postal and zip codes.

Addresses for reprints, changes of address and disclaimers should be given as footnotes and should use the same number system as addresses.

Naming an author on a paper implies that the person named is aware of the research reported, agrees with and accepts responsibility for any results or conclusions reported. The corresponding author shall ensure that all authors are aware of, agree with, and support publication of the manuscript.

3. Abstract

An abstract must be included with every paper or short communication submitted to the journals. The abstract should express precisely the most important information in the paper and should be intelligible in itself without reference to the paper, since abstracts are often published separately by abstracting journals. Include in the abstract the rationale for the study, the objectives, materials and techniques used, the names of relevant organisms, new theories and terminology and a conclusion. Do not include tables, figures or references or any information not carried in the text of the paper. Avoid acronyms, if possible.

The abstract is published in both English and French. The translation of the abstract also carries a translation of the title and key words. Authors should submit this material in both English and French if they are able to do so. The Publications Office will arrange for translation of the abstract if it is not provided by the authors.

Abstracts of papers should not exceed 200 words; abstracts of short communications should not exceed 50 words.

4. Introduction

The introduction (no heading) should state clearly the rationale for conducting the research stating the problem, justifying the research and the findings of earlier research and the objectives of the study.

ing the research and the findings of earlier research and the objectives of the study.

5. Materials and Methods

Subjects, materials and methods used should be described so that the work may be evaluated or repeated by other researchers. Well-known procedures and tests should not be described in detail but simply named or cited as a reference. Chemical procedures that are referenced should include a brief statement of the basic principles of the method.

6. Results and Discussion

Results and discussion may be presented as separate sections or combined under one heading. The Discussion section should interpret the data presented in the Results section with regard to the reason for the research presented in the introduction. Relate findings to previous research. Discuss agreement or conflict with previous work. State the conclusions of the research presented and present practical applications and avenues of future study. Scientific speculation should be identified as such; it should be reasonable, firmly founded in observations related in the manuscript and subject to experimentation.

7. References

Cite only references that are highly pertinent. Reference may be made to journal papers, books, theses, dissertations, proceedings, bulletins, reports and published abstracts as well as to unpublished documents held in a library or archive to which the public has access. Unpublished material not accessible to the public such as letters, memos, etc., should be included in the text, followed parenthetically by the statement, “personal communication” or “unpublished observation”, but should not be included in the reference list (see examples). Authors are responsible for ensuring that references are complete and accurate. Do not cite references in the abstract or in the conclusion.

Text Citations

The three journals use the name-and-year system (Harvard system) in which the author’s(s’) name(s) followed by the year of publication is cited in the text. If there are three or more authors, use the first author’s name followed by et al. (do not underline or italicize) on all occurrences. The use of parentheses depends on the sentence structure, for example:

Smith et al. (1990) observed fall growth...
 Fall growth was observed (Smith et al. 1990).
 Fall growth was observed (see, for example, Smith et al. (1990))

If the cited author(s) and year are identical for more than one reference insert lower case letters after the year in both text citation and reference list i.e.

Graham (1986a)
 Graham (1986b)
 Smith et al. (1990a)

Smith et al. (1990b)
(Graham et al. 1990a,b), etc.

Articles or reports issued by a government agency, committee or association should be cited using the name of the agency, which should be abbreviated on second and subsequent citations; the abbreviation should be given parenthetically on first citation:

One citation in text: (National Academy of Sciences-National Research Council 1990).

Two or more citations in text: (Association of Official Analytical Chemists (AOAC) 1989) and on second and subsequent citations: (AOAC 1989).

Citations should be inserted in the text immediately before a punctuation mark or at a logical break in the sentence.

When more than one reference is cited at the same location in a sentence, they should be arranged chronologically:

Several authors (Thomas 1982; Alex et al. 1983; Smith 1990) have shown...

The Reference List

References should be listed in the reference list alphabetically then chronologically if all authors are the same. A series of references with the same first author should be listed with the single author first, followed by two authors arranged alphabetically, and then multiple authors (et al. in text) arranged alphabetically thus:

Brown, A. B. 1980
Brown, A. B. 1983
Brown, A. B. and Clark, T. 1989
Brown, A. B. and Smith, S. 1988
Brown, A. B., Adams, B. and Smith, S. 1990
Brown, A. B., Smith, S. and Adams, B. 1989

If the senior author appears in more than one citation from multiple author papers then insert lower case letters after the year in both the text citation and the reference list:

Brown, A. B., Smith, S. and Adam, B. 1989a
Brown, A. B., Smith, S. and Miller, C. 1989b

Information for a reference should be taken from the original work being cited. Basic components for a journal reference are:

Last name, initials. Year. Title of paper. Journal title (abbreviated). Volume number: page numbers (first and last).

and for a book are:

Last name, initials. Year. Title of book. Edition. Publisher, place of publication. (See examples for treatment of chapters, sections, edited works, etc.)

Family names of authors (in upper and lower case) are followed by initials. When different authors share the same

family name and the same initial, the first given name for each author should be written in full.

In names of Dutch, French or German origin the article precedes the family name when transposed: e.g.

van Gogh, V.
de Maupassant, G.
von Schiller, J. C. F.

Jr. (Junior) and II, III, etc. follow the initials when transposed and are preceded and followed (if the name of another author follows) by a comma, e.g.

Smith, T., Jr.

Publications issued by government agencies, committees, etc., carry the name of the organization, which is treated as an author's name. The name of the editor, followed by the abbreviation (ed.), may be used. If authorship cannot be determined, the reference may be listed under "Anonymous".

Journal titles are abbreviated according to *BIOSIS Serial Sources* (2100 Arch Street, Philadelphia, PA 19103-1399). One-word journal titles are never abbreviated.

References should supply sufficient information to allow readers to trace the original material. Names of publishers should be given in full followed by the place of publication. For material originating in Canada or the United States of America, it is sufficient to supply the city and province or state. For material originating in other countries, the name of the country should also be given. The names of provinces and states are abbreviated in the reference list.

Examples of References

Standard journal article

Waterer, J. G. and Evans, L. E. 1985. Comparison of Canadian and American hard red spring wheat cultivars. *Can. J. Plant Sci.* **65**: 831-840.

Article with subtitle

Ackerson, R. C. 1981. Osmoregulation in cotton in response to water stress. I. Alterations in photosynthesis, leaf conductance, translocation and ultrastructure. *Plant Physiol.* **67**: 484-488.

Abstract/supplement

Robertson, J. B. and van Soest, P. J. 1977. Dietary fiber estimation in concentrate feedstuffs. *J. Anim. Sci.* **44**(Suppl. 1): 257 (Abstr.).

Article accepted, not yet published

Larveld, B., Kerr, D. E. and Brockman, R. P. 1986. Effects of growth hormone on glucose and acetate metabolism in sheep. *Comp. Biochem. Physiol.* (in press).

Article in foreign language

Ama, H. 1983. An introduction to applied cell biology. *Commun. Appl. Cell Biol.* **2**: 3-5. [in Japanese, English abstract.]

Standard book

Cochran, W. G. and Cox, G. M. 1968. Experimental design. 2nd ed. John Wiley and Sons, Inc., New York, NY. 611 pp.

Edited book, pages specified

Griffith, R. W., Hodel, C. H. and Matter, B. 1978. Toxicological considerations. Pages 805–851 in B. Berde and O. Schilde, eds. Ergot alkaloids and related compounds. Oxford University Press, Oxford, UK.

Edited book, editor referenced

Wood, R. K. (ed.) 1982. Defense mechanisms in plants. Plenum Press, Toronto, ON.

Corporate author

Association of Official Analytical Chemists. 1980. Official method of analysis. 13th ed. AOAC, Washington, DC.

Conference proceedings

Brouwer, R. and de Wit, C. 1968. A simulation model of plant growth. Proc. Easter School in Agricultural Science, University of Nottingham, UK. Butterworths, London, UK.

Thesis

Beck, M. J. 1980. The effects of kinetin and naphthaleneacetic acid on in vitro shoot multiplication and rooting in fishtail fern. M.Sc. Thesis, University of Tennessee, Knoxville, TN. 31 pp.

Charts

Royal Horticultural Society. 1966. RHS colour chart. RHS, London, UK.

Unpublished memos, letters, personal communications cited in text only

(A. J. Smith, personal communication, University of Saskatchewan, Saskatoon, SK)
(A. J. Smith, unpublished data).

Electronic publications

1. Individual works

1.1 CD-Rom

Author/editor. Year. Title (edition). [Medium]. Available: Supplier, mailing address; Internet address/database identifier or number¹.

Dirr, M. A. 1997. Photo-library of woody landscape plants on CD-ROM. [CD-ROM]. Available: Timber Press, Portland, OR; <http://www.timber-press.com/>

¹Note: Access date is not needed when the medium is a CD-ROM.

1.2 Internet site

Author/editor. Year. Title. [Medium] Available: Site/Path/File [Access date]

Irvine, B. 1998¹. Can producers use an in-row liquid suspension to inoculate pulse crops? [Online] Available: <http://res.agr.ca/brandon/brc/newsnote/newsI91.htm> [1 October 1998].

¹Write “Undated” when the electronic publication date is not available. Internet site publication dates are often provided as “last update” information either at the top or bottom of the page.

2. Parts of works

Author/editor. Year. Title. In Source (edition) [Medium] Available: Site/Path/File. [Access Date]

Kinsman, G. 1986. Blueberries in Nova Scotia. In The history of the lowbush blueberry industry in Nova Scotia 1880–1950. [Online] Available: <http://agri.gov.ns.ca/nsbi/wbic/hist/kinsman1880/index.htm> [27 Sept. 1998].

3. Electronic journal articles¹

Author. Year. Title. Journal Title. Volume². [Medium] Available: Site/Path/File [Access Date]

Bustamente, P. I. and Hull, R. 1998. Plant virus gene expression strategies. Electronic J. Biotech. 1. [Online] Available: <http://www.ejb.org/content/voll/issue2/full/3/> [31 Aug. 1999].

¹When a journal is published in dual media (e.g., print and online) the print version citation is preferred.

²Volume information may be omitted when an e-journal or magazine does not provide it.

4. Magazine articles (Internet)

Author. Year. Month. Article Title. Magazine Title. Volume. [Medium]. Available: Site/Path/File [Access Date].

Kupferman, E. 1999. March. How to prevent diseases of fruit in storage. Good Fruit Grower [Online] Available: <http://www.goodfruit.com/archive/Mar-99/cursplt.html> [31 Aug. 1999].

5. Newspapers (Internet)

Author. Year. Day. Month. Article Title. Newspaper Title. [Medium] Available: Site/Path/File [Access date].

Raine, M. 1998. 24 Sept. Fall fertilizing should be as late as possible. The Western Producer [Online]. Available: http://www.producer.com/docs/news/Sep_24_98/prod3.htm I [10 Oct. 1998].

Certain media have been omitted from these guidelines. Bulletin board listings, discussion group threads, electronic mail, etc., are not included since they usually represent nothing more than “personal communication” and can be cited as such according to present guidelines. There is little doubt that electronic publication will grow rapidly over the next few years. The lifetime and persistence of electronic articles (particularly on WWW sites) is sometimes uncertain and this represents a concern for scientists and information management professionals alike. It is important that reference lists in *Canadian Journal of Plant Science* articles are as current as possible at time of publication; authors are

encouraged to access and check cited electronic media immediately before submitting a final version of the paper. While the sometimes ephemeral nature of electronic sources of information poses problems for us all, we must provide our readers with the best possible path to the background information, which underpins each scientific article.

8. Short Title (Running Head)

The short title appears at the top of every right-hand page of a journal paper. It should not exceed 60 characters (excluding word spaces) and must include the name(s) of the author(s) (use et al. for three or more co-authors.)

Short titles are used as subentries in the annual subject index. A short title should therefore be an abbreviation of the paper title that will give a brief but accurate description of the main topic of the paper. The main title of the paper may be used in full as the short title if it is not too long. For cultivar descriptions the short title will usually be the same as the full title.

9. Key Words

A maximum of six key words or short phrases should be included with the manuscript. These will appear below the abstracts of the paper and will be translated into French.

Key words should be suitable for information retrieval systems and for the annual subject index (in conjunction with the short title) published in the journals (key words form the main entry of the index). Key words should be chosen from the title, abstract and body of the paper and should reflect its central topics. Avoid the use of vague nonspecific terms such as “yield”, “growth”, “in vitro”, etc. Adjectives are usually inverted unless they form part of an anatomic term or specific name or if the modified noun is nonspecific. For example:

Not acceptable

lactating cattle
winter wheat
low temperature
residue
in vitro propagation

Acceptable

cattle, lactating
wheat (winter)
propagation (in vitro)
lactic acid

Special Uses in the Canadian Journal of Plant Science

(a) Papers in the series “Biology of Canadian Weeds” should include the following key words: “Weed biology” and the botanical name of the weed(s) under discussion.

(b) Cultivar descriptions should include the following key words:

“Cultivar description” and the name of the crop being described; for example, for the cultivar “Pegasus faba bean”, use the key word “faba bean”; for the cultivar “Vuka

winter wheat”, use the key word “Wheat (winter)”. (Use the cultivar name in the short title, for example: “Pegasus faba bean”; “Vuka winter wheat”. The key word “Cultivar description” will then appear in the index as a main entry, the short title will appear as a subentry.)

(c) In crop names, descriptors should appear in parentheses after the name of the crop, e.g.

Wheat (winter)
Oat (wild)
Bean (navy)
Fern (Ostrich)

(d) Use common names of grasses, not botanical names, e.g.

Orchardgrass
Bentgrass
Ryegrass
Altai wildrye

(e) Use botanical names of plant diseases and pathogens, e.g.

Fusarium graminearum
Alternaria alternata

10. Trademarks

Authors are required to provide registered trademark notification for proprietary products.

11. Footnotes

Footnotes can be used and are required on the title page and in tables (see section on tables).

On the title page, footnotes will generally fall into one of the following categories:

(a) Notes on the title indicating the paper is part of a thesis submitted by one of the authors, that the paper was presented at a symposium (see section on symposia papers), etc.

(b) General disclaimer. If the use of trade or brand names is necessary in the text, the use of a disclaimer may be advisable. For example, “The use of trade names, proprietary produce or vendor does not imply endorsement by the authors, nor criticism of similar products not mentioned.”

(c) Current address of author(s) if it is not the one listed in the by-line or address for reprint requests.

(d) Indication that an author is deceased.

All footnotes on the title page are indicated by superscript arabic number. For table footnotes see the section on Tables (below).

12. Tables

Tables are used to present numerical data in a self-explanatory manner. They should be intelligible without consulting the text and should not duplicate data already given in the text or illustrations. Tables should be typed double-spaced, each table on a separate sheet. Place tables immediately after the list of figure legends or references if there are no figures. Paginate the tables in series with the text.

All tables should be cited in the text. Arabic numerals are used to number tables. Align horizontally parallel entries by their bottom lines. Do not use vertical rules in tables. Avoid the use of horizontal rules within the body of the table; if necessary, separate data sets by spaces.

Heading

Describe the topic and general trends of the table. Capitalize in sentence format and end without a period. Do not indent second and subsequent lines. Do not include units of measurement in the heading; place them following column or stub headings within the table.

Column Headings

Capitalize only the first word, proper nouns and capitalized abbreviations. Subheadings should be joined by a rule. Give units in parentheses on the last line of the column head. When several column headings share the same units of measurement, place the unit below the headings, centred, with rules on each side to indicate the headings to which they refer.

Body

Headings used within the body to separate subject classes should be centred and *italicized*. Use sentence capitalization. Centre entries under column heads. Centre data within columns on decimal points, dashes, \pm signs etc. If data have been excluded from the table, use an “en” dash. Do not use ditto marks to repeat data in columns.

Footnotes

Use bold lower-case letters in reverse starting with z^z, y, x, w, etc.) to designate footnotes. Set each footnote on a separate line, flush with the left-hand margin of the table. Include footnotes on all tables to which they refer, do not say “see footnote Table 1”. Place footnote symbols at the first occurrence in the table, working left to right, top to bottom. Explain in footnotes any unconventional abbreviations used in the table. The asterisk (*) is used only to designate Statistical significance, e.g., *, **, *** Significant at $P < 0.05$, $P < 0.01$ and $P < 0.001$, respectively.

Statistics

To indicate statistical significance, use either lower case letters (*a, b, c*, etc.) (italic, not superscript) or a single asterisk for the 5% level; upper case letters (*A, B, C*) or a double asterisk for the 1% level and a triple asterisk for the 0.1% level. Do not leave a space between the entry and letter. Mean comparison tests should be supported by significant F value in ANOVA designs.

13. Text Headings

Generally four levels of text heading are used:

1. **BOLD CAPITALS CENTRED**
2. **Bold Upper and Lower Case, Flush Left**
3. *Italic Upper and Lower Case, Flush Left*
4. CAPITALS AND SMALL CAPITALS. Run in to first line of text (when typing, end the heading with a period followed by a space).

14. Illustrations

For **submitted manuscripts**, illustrations must be embedded at the end of the text file (Word and WordPerfect graphics are acceptable for submitted manuscripts). For **accepted manuscripts** either hard copies or electronic versions of

Lettering size for 0 reduction
 Lettering size for reduction to 90%
 Lettering size for reduction to 80%
 Lettering size for reduction to 70%
 Lettering size for reduction to 60%
 Lettering size for 50% reduction

Fig. 1. Examples of lettering sizes for various reduction factors.

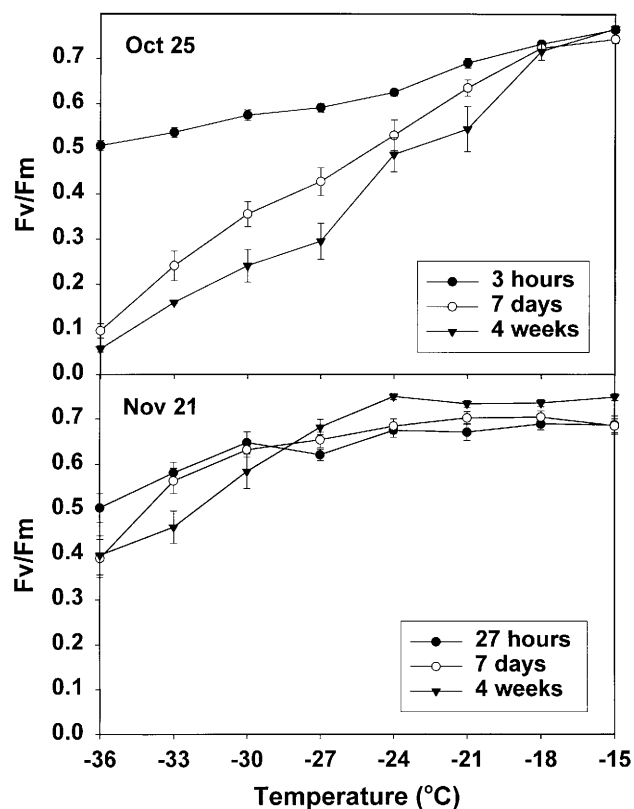


Fig. 2. The original of this figure has been reduced to fit the one-column format. The lettering and symbols are clear and the key to the symbols is included within the illustration.

graphics are acceptable. Graphics files must be compatible with QuarkXpress. The following file formats are acceptable: *.tif, *.bmp, *.gif, *.eps, *.pdf, *.jpg (for photographs; must be high resolution). Word and WordPerfect graphics files are not acceptable for accepted manuscripts. Images should be of sufficient resolution to print clearly (minimum 300 dpi for greyscale images; 600 dpi for colour images). Illustrations should be planned to fit one-column, two-column or full page formats. Lines must be sufficiently thick (minimum 0.5 points) to reproduce clearly, and lettering and symbols must be in proportion to the illustration and large enough to allow for reduction without loss of clarity (Figs. 1 and 2). Use clear, bold patterns; avoid the use of fine grey scale patterns, which will plug when scanned and printed.

Labelling on graphs should be parallel to the graph's axes. Abbreviations, units, etc. should follow journal style. Photographs are best submitted close to final size and should be clear black and white prints with good tonal contrast. Illustrations (line or photograph) should not be mounted. Use uppercase letters to mark subdivisions. Colour photographs are accepted but authors are expected to pay the full cost of reproduction. Contact the journal office for advice on how best to submit colour illustrations. All illustrations should be labelled on the back in pencil with the senior author's name and the figure number. Illustrations produced on dotmatrix printers are not acceptable. Papers that do not have good-quality illustration will not be published.

Colour photographs are accepted, but the full cost of colour separation and printing is borne by the author.

To differentiate bars within bar graphs use patterns rather than shades of grey. When scanned and reduced, differences in grey scales are often indistinguishable (Fig. 3). Use line patterns with ample space between the lines (Fig. 4).

Lettering on illustrations should be approximately 2 mm high when reduced. Use the same size of lettering throughout the illustration; use SI units and follow journal style for capitalization, abbreviations, italicization, etc. (use kg ha^{-1} not kg/ha ; use L not l for litre).

Photographs are best submitted at final size and should be clear, glossy black and white prints with sharp focus and good tonal contrast. Previously screened photographs are not acceptable.

15. Standard Format for the Description of New Cultivars and Germplasm

The *Canadian Journal of Plant Science* publishes descriptions of new original cultivars and germplasm as scientific notes. Cultivars and germplasm may be of agronomic crops (grains, oilseeds, forages), horticultural crops (fruits, vegetables, ornamentals, herbs) or non-food crops such as tobacco. Cultivar descriptions will only be considered for crops intended for Canadian production.

Title

Include the cultivar or germplasm name followed by the common name of the species.

Introduction

The introductory paragraph should include the full botanical name and authority.

Breeding Methods and Pedigree

This section should include the breeding methods used and the pedigree of the cultivar or germplasm. The names of individuals, agencies or organizations involved in the breeding must be cited. The original developer or breeder should be identified as an author.

Performance

The areas of adaptation should be identified. Outstanding characteristics should be identified. Table(s) of comparative data should emphasize the superior traits of the cultivar or

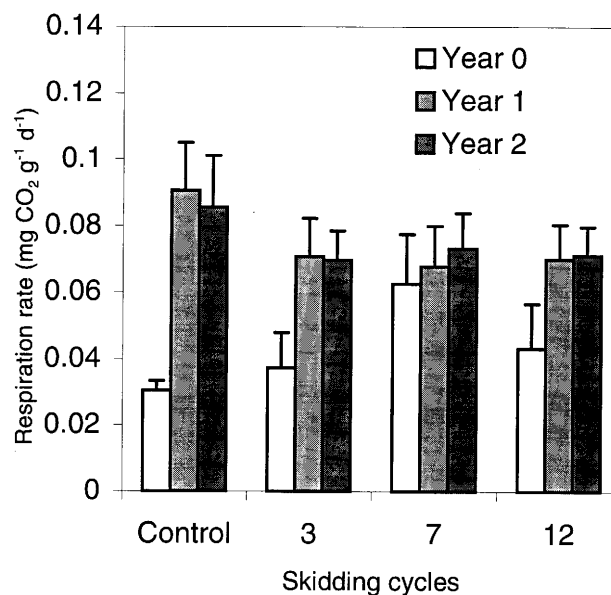


Fig. 3. The use of grey scale shading will make year 1 and year 2 indistinguishable when printed.

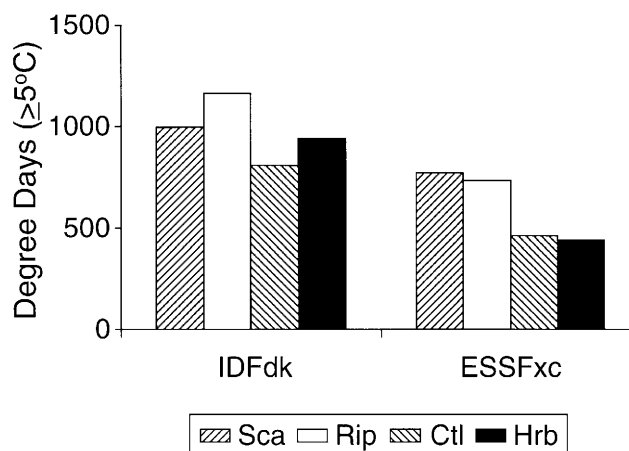


Fig. 4. A better example of a bar graph.

germplasm. Statistical analysis must be applied to quantitative data and tests of significance or SE provided as a measure of variability.

Other Characteristics

Any other characteristics that illustrate the uniqueness and/or superiority of the cultivar or germplasm must be identified.

Availability of Propagating Material

The address of the individual, agency or organization responsible for maintaining and distributing pedigreed seed or clonal material of a cultivar should be stated. Any restrictions imposed by the originator(s) on the further propagation of the cultivar or germplasm should be stated. For cultivar descriptions of agricultural crops, the cultivar must first be registered in Canada with the Variety Registration Office of

the Canadian Food Inspection Agency (CFIA) where this requirement exists for Canadian release. The CFIA registration number must be mentioned in the description.

Under Canadian Seeds Regulations, Trade Marks or Brand names may not be used as part of a cultivar name. Full details on these regulations are available on the CFIA cultivar registration web page at www.inspection.gc.ca/english/plaveg/variet/vartoce.shtml. If a plant patent applies, the number and date of the patent should be given.

The plant Gene Resources of Canada accession number of the cultivar/germplasm should be given.

Other Information

Acknowledgements, references, tables and figures should conform to guidelines for papers and short communications.

C. SPECIFIC STYLE GUIDE

1. Units of Measure

SI System

The SI system of units (*Système international d'unités*) is required for use in the AIC journals. The SI is based on seven base and two supplementary units (Table 1). One principal advantage of the SI is that all other units in the sys-

Table 1. SI base and supplementary units

Quantity	Name of unit	Symbol of unit
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol
Plane angle	radian	rad
Solid angle	steradian	sr

Table 2. SI derived units with special names

Quantity	Name	Symbol	Expression in terms of other units	Expression in terms of SI base units
Frequency	hertz	Hz	B	s ⁻¹
Force	newton	N	B	m ⁻¹ kg s ⁻²
Pressure, stress	pascal	Pa	N m ⁻²	m ⁻¹ kg s ⁻²
Work, energy, quantity of heat	joule	J	N m	m ² kg s ⁻²
Power, radiant flux				
Electric charge, quantity of electricity	watt	W	J s ⁻¹	m ² kg s ⁻³
	coulomb	C	B	s A
Electric potential	volt	V	W A ⁻¹	m ² kg s ⁻³ A ⁻¹
Electric capacitance	farad	F	C V ⁻¹	m ⁻² kg ⁻¹ s ⁴ A ²
Electric resistance	ohm	Ω	V A ⁻¹	m ² kg s ⁻³ A ⁻²
Electric conductance	siemens	S	A V ⁻¹	m ⁻² kg ⁻¹ s ³ A ²
Magnetic flux	weber	Wb	V s	m ² kg s ⁻² A ⁻¹
Magnetic flux density	tesla	T	Wb m ⁻²	kg s ⁻² A ⁻¹
Inductance	henry	H	Wb A ⁻¹	m ² kg s ⁻² A ⁻²
Celsius temperature	degree Celsius	°C	B	K
Luminous flux	lumen	lm	B	cd sr
Illumination	lux	lx	lm m ⁻²	m ⁻² cd sr
Activity (radionuclide)	becquerel	Bq	B	s ⁻¹
Absorbed dose (radiation)	gray	Gy	J kg ⁻¹	m ² s ⁻²
Dose equivalent	sievert	Sv	J kg ⁻¹	m ² s ⁻²

tem can be derived from the base units by simple multiplication and division. Examples of derived units are the unit of area (m²), the unit of volume (m³), the unit of velocity (m s⁻¹), etc. Some derived units have been assigned special names (Table 2).

In addition, certain non-SI units are so widely used in everyday life that they have been retained for general use with the SI; a few others have been accepted for use with the SI "for a limited time" (Table 3).

Usage

On many occasions, the SI base and derived units are inconveniently large or small. Hence prefixes are used to form multiples or submultiples of the units (Table 4). Prefixes are written immediately before the symbol of the units to which they apply with no intervening space or punctuation. They should never be used alone (e.g., μ for micron is unacceptable; rather μm), nor should compound prefixes ever be used (e.g., mμm for millimicrometre; instead use nm, nanometre).

It is preferable to use prefixes in multiples of 10³ and therefore to avoid deci, centi, deca, and hecto whenever possible. Notable exceptions are the centimetre (cm) and the hectare (ha). Units, however, should be chosen with prefixes so that the numerical component falls between 0.1 and 1000.

When a unit is in a fractional form, the prefix should be applied to the numerator only. (Because it is the only base unit defined with a prefix, the kilogram is of course an exception.)

Style and Format

Use the symbol for a standard unit of measurement only if it is preceded by a number. Spell out a unit's name if it follows a spelled out number (for example, opening a sentence). Do not begin a sentence with a symbol or abbreviation.

Table 3. Non-SI units that are retained for general use or accepted for use with the SI

Quantity	Name	Symbol	Value in SI units
Time	minute	min	60 s
	hour	h	3 600 s
	day	d	86 400 s
	month	mo	604 800 s
	year	yr	–
Angle	degree	...°	$\pi/180$ rad
	minute	...'	$\pi/10\ 800$ rad
	second	...''	$\pi/648\ 000$ rad
Mass	tonne	t	1000 kg or 1 Mg
Volume	litre	L	1 dm ³ or 10 ⁻³ m ³
Area	hectare	ha	10 000 m ² or 10 ⁻² km ²

Table 4. SI prefixes

Factor	Multiples		Submultiples		
	Prefix	Symbol	Factor	Prefix	Symbol
10 ¹⁸	exa	E	10 ⁻¹	deci	d
10 ¹⁵	peta	P	10 ⁻²	centi	c
10 ¹²	tera	T	10 ⁻³	milli	m
10 ⁹	giga	G	10 ⁻⁶	micro	μ
10 ⁶	mega	M	10 ⁻⁹	nano	n
10 ³	kilo	k	10 ⁻¹²	pico	p
10 ²	hecto	h	10 ⁻¹⁵	femto	f
10 ¹	deca	da	10 ⁻¹⁸	atto	a

Numbers and units that form compound adjectives should be hyphenated, e.g.,

1000-kernel weight, 2-mo-old calf, 15-mm opening, 15-cm-deep layer.

The denominators of units derived by division should be written with negative indices. Do not use a solidus (/) unless the units are written in full, e.g.,

kg ha⁻¹ yr⁻¹, W m⁻² but metre/second

A space (not a dot) is left between the elements of a unit and between the numerical value and the first letter of the unit's symbol, except for the symbols of degree, minute, and second, e.g., 91 m (not 91m, which could mean 91 metres or 9 lumens), N m (newton-metre, not m N for metre-newton, which if the space were omitted is the symbol for millinewton), but 45°30'20", 25°C.

When numerical values are less than one, a zero must be written before the decimal marker, e.g., 0.3. In a series of measurements, place the unit at the end, e.g., 3–10°C; 1, 4, and 8 μg L⁻¹. Units whose name is derived from a proper name are not capitalized when written out in full, but the first letter of the unit's symbol is, e.g.,

K (kelvin), Pa (pascal), but °C (degree Celsius)

Special Uses

The adoption of the SI has created difficulties, and some confusion, in reporting concentration, exchange capacity, soil water potential, and light.

(i) The amount of substance concentration, or, simply, concentration, can be expressed, for example, as concentration in HCl = 0.1 mol L⁻¹ or 0.1 M HCl.

The base unit mole (mol) replaces such terms as gram-molecule and gram-equivalent. The concept of equivalence and the corresponding amount of substance concentration that it defines, i.e., normality (N), should therefore no longer be used. Concentration in mol L⁻¹ can also be reported as molarity (M) of a solution, as in the above example.

Concentration can also be expressed on a mass or volume basis. This could be the case, for example, for nutrient concentrations in plants, soils, and fertilizers, or for soil and plant water contents, e.g.,

mmol kg⁻¹, mg kg⁻¹, g m⁻³ or g kg⁻¹

The use of percent (%) must be avoided whenever SI base or derived units can be used instead. Nevertheless, percent is acceptable for such quantities as coefficient of variation, plant or animal population estimates, increases or decreases in yield, fertilizer grades, relative humidity, soil texture, base saturation, land area estimates.

As with percentage, parts per million or billion (ppm or ppb) can be equally ambiguous, and are therefore unacceptable. Use instead units such as μL L⁻¹, mg L⁻¹, or mg kg⁻¹.

(ii) Exchange capacity of soils has traditionally been expressed in millequivalents (meq) per 100 g. Neither the numerator nor the denominator of this unit conforms to SI usage. In SI base units, exchange capacity and exchangeable ion composition are expressed as moles of charge, either positive (+) or negative (–), per unit mass of soil, e.g., mmol kg⁻¹. It is not necessary to include the + or – signs, as the polarity of the charges should be evident from the context. Thus, in expressing exchangeable calcium for example 4 meq Ca²⁺ 100 g⁻¹ would become 40 mmol (2 Ca²⁺) kg⁻¹ or 20 mmol Ca²⁺ kg⁻¹ in the SI. If cation exchange capacity is determined by the single-ion saturation method, then the ion used should be specified, e.g., 130 mmol (2 Mg²⁺) kg⁻¹, the reason being that the saturating ion can influence the measured cation exchange capacity.

(iii) Soil water potential can be expressed in three different units depending upon whether it refers to energy per unit mass, volume, or weight of soil water. On a mass basis, the SI unit is the joule per kilogram (J kg⁻¹); on a volume basis, the unit is the pascal (Pa); whereas on a weight basis, water potential is reduced to a height of water column expressed in metres (m). If using pressure units (i.e., energy on a volume basis), a convenient multiple is the kilopascal (kPa) which is numerically equivalent to J kg⁻¹.

(iv) The purpose for which a study is undertaken determines the units that should be used for light intensity. In studies based on radiant energy received from a light source, the accepted SI units are the joule per square metre (J m⁻²) for total radiant energy received or the watt per square metre (W m⁻²), which expresses energy received per unit area or irradiance.

Plants respond to photosynthetically active radiation (PAR) in the waveband 400 to 700 nm. The proper quantity to measure in this case is the flux density of quanta received

per unit area, which is expressed in micromoles per square metre per second ($\mu\text{mol m}^{-2} \text{s}^{-1}$). This latter unit replaces the non-SI Einstein (E), which is equivalent to one mole quanta. When other wavelengths are considered, the waveband should be specified.

In animal physiology studies, light measurements can be reported in lux (lx). This measurement refers to the intensity of light, or illuminations, as perceived by the human eye (and also by the animal, presumably). Thus the lux is an inappropriate unit for use in the plant sciences.

2. Abbreviations

Generally, abbreviations in upper case do not have periods and are not letter-spaced, e.g., DM, RH. Abbreviations in lower case usually have periods, but no letter spacing: e.g., a.i. (active ingredient), i.d. (inside diameter).

A list of abbreviations used must be supplied, which will be printed on the first page of the paper. Abbreviations widely used throughout science, such as DNA, can be used in titles, abstract and text without definition. Other abbreviations must not be used in titles, but may be used in the text if they are parenthetically defined at first use. An abbreviation should not be used unless the abbreviated term is used at least three times in the manuscript. Plural abbreviations do not require a final "s". Refer to *Scientific Style and Format* (6th edition) for additional standard abbreviations.

Abbreviations of Words Used in Citations

(Note: AIC Journal style is to include the period following the abbreviated journal title. This is contrary to *Scientific Style and Format*, which recommends omission of the period.)

Abstract, Abstr.
Agriculture, Agric.
Annals, Ann.
Annual, Annu.
Association, Assoc.
Bulletin, Bull.
Circular, Circ.
Edition, Editor(s), ed, eds.
Experiment, exp.
Extension, Ext.
International, Int.
Miscellaneous, Mis.
Monograph, Monogr.
National, Natl.
Proceedings, Proc.
Publication, Publ.
Report, Rep.
Research, Res.
Station, Sta.
Supplement, Suppl.
Technical, Tech.
University, Univ.

Abbreviations of Frequently Cited Periodicals (Refer to Biosis List of Serials with Title Abbreviations: <http://www.biosis.org.uk>)
Acta Agric. Scand.

Acta Endocrinol.
Acta Hortic.
Adv. Carbohydr. Chem.
Adv. Genet.
Adv. Protein Chem.
Agric. Eng.
Agron. J.
Am. J. Anat.
Am. J. Bot.
Am. J. Clin. Nutr.
Am. J. Clin. Pathol.
Am. J. Hum. Genet.
Am. J. Obstet. Gynecol.
Am. J. Pathol.
Am. J. Physiol.
Am. J. Soil Sci.
Am. J. Vet. Res.
Analyst
Anal. Biochem.
Anal. Chem.
Anat. Rec.
Anim. Behav.
Anim. Breed. Abstr.
Anim. Feed Sci. Technol.
Anim. Prod.
Ann. Bot. (Lond.)
Ann. Eugen.
Ann. Hum. Genet.
Ann. Math. Statist.
Ann. Zootech. (Paris)
Annu. Rev. Biochem.
Annu. Rev. Pharmacol. Toxicol.
Annu. Rev. Physiol.
Antibiot. Chemother.
Appl. Environ. Microbiol. (name since 1976)
Appl. Microbiol. (name since 1976)
Arch. Biochem.
Arch. Biochem. Biophys.
Arch. Tierz.
Aust. J. Agric. Res.
Austr. J. Biol. Sci.
Austr. J. Exp. Agric. Anim. Sci.
Austr. Vet. J.

Bacteriol. Rev.
Biochemistry
Biochem. Biophys. Acta
Biochem. Biophys. Res. Commun.
Biochem. J.
Biogeochemistry
Biol. Chem.
Biol. Fertil. Soils
Biol. Reprod.
Biol. Rev.
Biometrics
Bioscience
Blood
Br. J. Nutr.

- Br. Poultr. Sci.
 Br. Vet. J.
- Can. J. Anim. Sci.
 Can. J. Biochem. Physiol.
 Can. J. Bot.
 Can. J. Genet. Cytol.
 Can. J. Microbiol.
 Can. J. Plant Sci.
 Can. J. Res.
 Can. J. Soil Sci.
 Can. J. Zool.
 Can. Med. Assoc. J.
 Can. Vet. J.
 Cereal Chem.
 Chem. Ind.
 Clays Clay Miner.
 Clin. Toxicol.
 Clim. Change.
 Commun. Soil Sci. Plant Anal.
 Cornell Vet.
 Crop Sci.
- Ecol. Monogr.
 Ecology
 Econ. Bot.
 Endocrinology
 Environ. Sci. Technol.
 Equine Vet. J.
 Eur. Assoc. Anim. Prod.
 Eur. J. Biochem.
 Eur. J. Soil Sci.
 Eurasian Soil Sci.
 Exp. Agric.
- Farm Res.
 FEBS Lett.
 Fed. Proc.
 Fert. Steril.
 Food Chem.
 Food Cosmet. Toxicol.
 Food Technol.
 Gastroenterology
 Genetics
 Grass Forage Sci.
 Growth
 Gut
- Heredity
 Horm. Behav.
 HortScience
 Hort. Sci.
- Indian J. Vet. Sci. Anim. Husb.
- J. Agric. Food Chem.
 J. Agric. Res.
 J. Agric. Sci. (Camb.) if published in England. Include country of publ. for other countries (e.g., Neth. J. Agric. Sci.)
- J. Am. Chem. Soc.
 J. Am. Med. Assoc.
 J. Am. Oil Chem. Soc.
 J. Am. Soc. Hort. Sci.
 J. Am. Statist. Assoc.
 J. Am. Vet. Med. Assoc.
 J. Anim. Sci.
 J. Appl. Ecol.
 J. Appl. Meteorol.
 J. Appl. Physics
 J. Appl. Physiol.
 J. Assoc. Off. Anal. Chem.
 J. Bacteriol.
 J. Biol. Chem.
 J. Br. Grassl. Soc.
 J. Can. Inst. Food Technol.
 J. Cell Physiol.
 J. Chromatogr.
 J. Clin. Endocrinol. Metab.
 J. Clin. Invest.
 J. Clin. Pathol.
 J. Dairy Res.
 J. Dairy Sci.
 J. Ecol.
 J. Econ. Entomol.
 J. Endocrinol.
 J. Environ. Pathol. Toxicol.
 J. Environ. Qual.
 J. Equine Med. Surg.
 J. Exp. Biol.
 J. Exp. Bot.
 J. Exp. Med.
 J. Food Sci.
 J. Gen. Microbiol.
 J. Gen. Physiol.
 J. Geophys. Res.
 J. Gerontol.
 J. Hered.
 J. Immunol.
 J. Infect. Dis.
 J. Lab. Clin. Med.
 J. Lipid Res.
 J. Morphol.
 J. Nutr.
 J. Pathol.
 J. Pathol. Bacteriol.
 J. Pharmacol. Exp. Ther.
 J. Physiol.
 J. Prod. Agric.
 J. Range Manage
 J. Reprod. Fertil.
 J. Sci. Food Agric.
 J. Soil Sci.
 J. Soil Water Cons.
 J. Toxicol. Environ. Health
 J. Vet. Res.
 J. Vet. Sci. Anim. Ind.
- Lab. Anim.
 Lipids
 Livest. Prod. Sci.

Meat Sci.
Metabolism

Nat. Can. (Que.)
Nature (Lond.)
Neuroendocrinology
N.Z. J. Agric. Res.
N.Z. Vet. J.
Nucleonics
Nutr. Abstr. Rev.
Nutr. Metab.
Nutr. Rep. Int.

Obstet. Gynecol.
Pharmacol. Rev.
Physiol. Rev.
Plant Dis.
Plant Physiol.
Physiol Plant.
Phytochemistry
Phytopathology
Plant Soil
Poult. Sci.
Proc. Br. Nutr. Soc.
Proc. Meat Ind. Res. Conf.
Proc. Nutr. Soc.
Proc. Recip. Meat Conf.
Proc. R. Soc. (Lond.)
Proc. Soc. Exp. Biol. Med.
Prog. Lipid Res.

Rec. Prog. Horm. Res.
Residue Rev.

Science
Sci. Agric.
Sci. Hortic
Soil Biol. Biochem.
Soil Sci.
Soil Sci. Soc. Am. J.
Soil Sci. Soc. Am. Proc.
Soil Tillage Res.
Soil Use Manage.
Steroids
Swed. J. Agric. Res.

Theor. Appl. Genet.
Theriogenology
Toxicol. Appl. Pharmacol.

Vet. Rec.
Vet. Res.

Water Resour. Res.
Weed Sci.
Weed Technol.
World's Poult. Sci. J.

Z. Tierz. Zuchtungsbiol.
Zentralbl. Veterinarmed Reihe A (B)

International Feed Names and International Feed Numbers (IFN)

Each feedstuff referred to in the manuscript may be identified by the International Feed Number (IFN) and a simplified name of the feed. The IFN, when used, should be listed only once in the manuscript, preferably in tables if tables listing feeds are included. If no table of feed ingredients is included then the IFN should be given in parentheses following the feed name in the Materials and Methods section. The use of the IFN makes the full description of the International Feed names redundant and space consuming. Thus, simplified names for the full description of the International Feed Names should be used in the text and tables as indicated in the examples for the following feeds:

Clover, red, hay sun-cured, early bloom (IFN 1-02-400)
Soybean, seeds, meal solvent extracted (IFN-5-04-604)

In the text they should be written as ... red clover hay (IFN 1-01-400), barley (IFN 4-00-549) and soybean meal (IFN 5-04-604) were fed. In tables they should appear as shown below:

Ingredient (%)
Barley (IFN 4-00-549) (78.6)
Soybean meal (IFN 5-04-604) (18.0)

The international Feed Names and IFN are listed in Utah Agricultural Experiment Station Bulletin 501 (1981). Copies of the bulletin may be obtained from: The Utah Agricultural Experiment Station, Bulletin Room, Utah State University, UMC 50, Logan, UT 84322.

Many different names are used in describing feedstuffs, but to establish a common basis for comparing nutritive values it is essential that the exact IFN given for the specific International Feed Name in this bulletin be used. If a feed ingredient is not exactly described in Bulletin 501, write to: Director, International Feedstuffs Institute, Utah State University, UMC 46, Logan, UT 84322, and an International Feed Name and IFN will be provided.

3. Time

Use the 24-h clock system: 0930, 1340, etc. Give day length in quantitative hours (e.g., 2 h 16 min). Abbreviate the terms hours (h), minute (min), second (s) and year (yr), month (mo), week (wk), when used with a number in the text but spell them out when they are used alone.

4. Dates

Use arabic numerals for all dates. Abbreviate the month (except May, June and July) when it is used with the date (day) but spell out the name of the month when it is used alone or with the year. Do not put commas between day, month and year.

Abbreviations are:

Jan., Feb., Mar., Apr., Aug., Sep., Oct., Nov., Dec.

Give dates in the order: year, month, day (2003 Sep. 01). When referring to a space of years give both years in full, e.g., 1980–1983 rather than 1980–83.

When referring to a group of continuous years, add the plural "s" without an apostrophe. e.g. 1970s.

Abbreviations BC, AD, BP should be capitalized.

5. Places

Spell out the names of countries, provinces and states when they are used alone; abbreviate them when they are used with the city, in footnotes and in references. List of abbreviations:

Provinces

Alberta, AB
British Columbia, BC
Manitoba, MB
New Brunswick, NB
Newfoundland, NL
Northwest Territories, NT
Nova Scotia, NS
Ontario, ON
Prince Edward Island, PE
Quebec, QC
Saskatchewan, SK
Yukon Territory, YT

United States of America and Territories

Alabama, AL
Alaska, AK
Arizona, AZ
Arkansas, AR
American Samoa, AS
California, CA
Canal Zone, CZ
Colorado, CO
Connecticut, CT
Delaware, DE
District of Columbia, DC
Florida, FL
Georgia, GA
Guam, GU
Hawaii, HI
Idaho, ID
Illinois, IL
Indiana, IN
Iowa, IA
Kansas, KS
Kentucky, KY
Louisiana, LA
Maine, ME
Maryland, MD
Massachusetts, MA
Michigan, MI
Minnesota, MN
Mississippi, MS
Missouri, MO
Montana, MT
Nebraska, NE
Nevada, NV
New Hampshire, NH
New Jersey, NJ
New Mexico, NM

New York, NY
North Carolina, NC
North Dakota, ND
Ohio, OH
Oklahoma, OK
Oregon, OR
Pennsylvania, PA
Puerto Rico, PR
Rhode Island, RI
South Carolina, SC
South Dakota, SD
Tennessee, TN
Texas, TX
Utah, UT
Vermont, VT
Virginia, VA
Virgin Islands, VI
Washington, WA
West Virginia, WV
Wisconsin, WI
Wyoming, WY

Translate the names of foreign cities and countries into English in text and authors by-line. Street addresses, institutional names, etc. retain their foreign spelling.

6. Statistics

Place emphasis on the interpretation of the experimental results based on a sound statistical methodology. Experimental designs, data, statistical model, and analyses must be clearly described, more fully in non-standard designs. Reference to a computer program used in analysis is not sufficient description of design. The experimental design should be appropriate to the objectives of the experiment and the statistical procedure(s) should be appropriate for the design. If necessary, data should be transformed to satisfy assumptions required for valid statistical analysis. In combined analyses, error variances should be homogeneous or heterogeneity should be taken into account in the analysis.

Summary statistics should be accompanied by estimates of their precision. Means usually should be accompanied by either the standard error of the mean, the standard error of the difference between means, or a confidence interval. The number of replicates used or the degrees of freedom should be indicated. If emphasis is on the spread of the data values, then the standard deviation or the range may be given. If a mean (\bar{x}) and standard error of a mean ($s_{\bar{x}}$) have been calculated on transformed data, back transformed values should be presented; one procedure of doing this is to transform the range of values ($\bar{x} - s_{\bar{x}}$ to $\bar{x} + s_{\bar{x}}$) back onto the original scale of measurement.

The statistical procedure used for separation of means should be appropriate for the data being analyzed. For example, fitting response functions using regression techniques or using planned sets of contrasts among means or groups of means are appropriate where treatments are graded levels of a quantitative variable or where there are combinations of two or more factors at two or more levels,

whereas multiple comparison tests are appropriate when unstructured qualitative treatments are involved.

Statistical hypothesis testing is an important aspect of analyzing experimental results. The author(s) should indicate what probability level is being used for the rejection of a null hypothesis. Probability levels commonly used are $P < 0.05$ and $P < 0.01$, with $P < 0.001$ and $P < 0.1$ being used rarely. Rigid use of $P < 0.05$ or $P < 0.01$ will often form a dichotomy, which is artificial and unnecessary; an effect with probability of $P = 0.049$ might be declared significant but a second at $P = 0.051$ might not be. When the null hypothesis is not being rejected at a prespecified level, the observed probability level should be stated, for example $P = 0.056, 0.078, 0.095$, etc. Also, if acceptance of the hypothesis that there is no difference is of importance, it would be of value to state the observed probability level, for example $P = 0.65, 0.92$, etc. In presenting correlation coefficients and mean squares, $P < 0.05$ (*), $P < 0.01$ (**), and $P < 0.001$ (NS) may be used since the reader can apply or determine other probability levels if desired. When relevant, mean squares should be presented rather than significance of F tests (i.e., *, **, and NS) since the latter alone do not provide the reader with basic information. As a matter of clarity and logic, when tests of significance indicate no difference, state that there was “no (significant) difference”, rather than saying “the difference was non-significant”.

The GLM procedure of SAS has been widely used for analysis of variance; however, it was designed to analyze data having fixed effects only. Models that have both fixed and random effect should be analyzed using the MIXED procedure of SAS. This is also important in analyzing data-sets with repeated observations on the same experimental unit that have heterogeneous variances over time and/or unequal within subject time-dependent correlations.

The Canadian Journal of Animal Science will not normally accept papers reporting the use of the GLM procedure to analyze data-sets that include random effects or repeated measurements on the same experimental unit where the data show heterogeneous variances and/or unequal within subject time-dependent correlations.

Avoid reporting a number of similar experiments separately; combine when possible. Omit raw data, information that can be calculated by the reader, and material irrelevant to the objectives. Results that are not significant may be included when relevant but may best be covered in the text rather than in tables or figures. Give only meaningful digits. A practical rule is to round, so that the change caused by rounding is approximately one-tenth of the standard error. Such rounding increases the variance of the reported value by less than 1%, so that less than 1% of the relevant information contained in the data is sacrificed.

7. Numbers

Follow the rules given below for writing numbers:

- Spell out numbers one through nine and use numerals for 10 and above and in instances given below.

- Use arabic numerals with abbreviated units of measure: 2 g, 5 d, \$4.00, 3% and numerical designations in the test: exp. 1, group 3, etc.
- Use arabic numerals to express time and date: 2003 Sep. 01 0800, etc.
- In a series using some number less than 10 and some more than 10, use numerals for all:
2 Holsteins, 6 Charolais and 15 Friesians ...
- When using numbers of more than four digits leave a space between each group of three going from the decimal point:
10 000, 450 000, etc.
- Numbers of two to four digits are run together:
3500, 1000, etc., except when they are used (e.g. in tables) in columns with numbers of more than four digits, when a space is inserted after the third digit from the decimal point:
23 000
450 000
1 200
- When writing a large number ending in several zeros use a word for part of the number:
1.8 million rather than 1 800 000.
- When two numbers appear adjacent to each other spell out the first:
ten 2-d-old chicks, rather than 10 2-d-old chicks.
- Do not begin a sentence with a numeral; spell it out or rearrange the sentence.
- Follow the same rules for ordinals as for whole number:
first, third, 1st, 3rd.
- When enumerating a discussion the use of secondly, thirdly, etc. is incorrect; use first, second, third, etc.

8. Equations

Use the simplest form of the equation possible especially in non-displayed equations in the text, e.g., use $(a + b)/(c + d)$ rather than $\frac{a + b}{c + d}$

Ensure that possibly ambiguous characters are clear (1, one/ell; 0, zero/oh; k/K; c/C; u/U/V/V, etc.). Single letter mathematical abbreviations are usually set in italics; abbreviations of more than one letter (max., ln, avg.), chemical symbols and numbers are not italicized. When subscripts and superscripts are combined indicate which one comes first.

Number equations with arabic numerals in parentheses at the right margin of the text; refer to equations in the text as “Eq. 4”.

PART III. THE BIOLOGY OF CANADIAN WEEDS

Revised Instructions and Format, Updated Lists of Accounts Published and In Preparation

P. B. Cavers¹, S. I. Warwick², and D. R. Clements³

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Three years ago, we published a revised format for the series on the Biology of Canadian Weeds, as well as instructions for the preparation of Updates of Previous Accounts (Cavers and Warwick 2000). This led to renewed interest in the series with 15 new accounts and two updates being published from April 2000 to October 2003. In addition, four new accounts and two updates have been accepted for publication, pending revision. There have also been many changes in the list of manuscripts in preparation. Since there are also a number of changes that need to be made in the Format and the Instructions to Authors, we are reprinting all of this information here.

The term “weed”, as used in this series, refers to any vascular plant that perpetuates itself in habitats where it is not wanted. Individual contributions should contain accounts of a single weed species or a group of related species.

Prospective authors should note that a new series, the Biology of Invasive Alien Plants in Canada, is being launched in this journal issue (Warwick et al. 2003). Before submitting an offer of contribution, authors should consider carefully the status and history of their species in Canada and then select the appropriate series. The Biology of Canadian Weeds series addresses undeniable problematic weeds in Canada, whereas the new series is designed to cover aliens in Canada that have demonstratable potential risk. In cases where the assignment to a particular series is not clear, the editors of both series may be called upon to make a judgment call. Please consult the new series (Warwick et al. 2003) for further information.

If you wish to write an account on a weed species, you must first check to ensure that the species has not been assigned to someone else. This involves sending an “offer of contribution” to Dr P. Cavers. After approval of your offer, you may proceed with writing the paper. The completed paper is to be submitted directly to the Canadian Journal of Plant Science (see below).

Offers of contributions by individuals or groups should be made to Dr. Paul B. Cavers, Department of Biology, University of Western Ontario, London, Ontario, N6A 5B7, e-mail pcavers@uwo.ca. These offers of contributions will be subject to approval by a committee of the Canadian Weed Science Society (CWSS). Approved offers will be subject to re-approval after three years if the article

has not been completed during that period. Any inquiries about the format to be used or advice on preliminary drafts should be directed to Dr. Cavers. He can also supply blank maps of Canada and will suggest specialists or institutions that will provide various types of services for authors. The Canadian Weed Science Society has a web site [<http://cwss-scm.ca/>] with on-line references to common English and French names, links to provincial and federal legislation and current lists of species published and in preparation for this series.

The finished manuscript should be submitted to: Canadian Journal of Plant Science; Mr. T. Fenton, Head, Journals Section, Agricultural Institute of Canada, 141 Laurier Ave. W., Suite 1112, Ottawa, Ontario, Canada K1P 5J3. All contributions must comply with the format of this journal. Accounts on a single species, including all maps, drawings, diagrams and photographs, should not exceed 50 pages [12 point font, double-spaced with numbered lines]. Of course, accounts on more than one species can be longer. The authors should also provide the names and addresses [including phone numbers and e-mails if available] of three potential referees.

A. REVISED FORMAT

TITLE: Each account will be given a number when it is accepted for publication. The number will be part of the title and precede the species name, e.g., The Biology of Canadian Weeds. 118. *Artemisia vulgaris* L.

1. Name

Give the scientific name (genus, species, and nomenclatural authority) currently accepted by plant taxonomists and the recommended English and French vernacular names of the weed that are given in *Common and botanical names of weeds in Canada* (Darbyshire et al. 2000). Also, list synonyms that are used in the weed literature with a source citation for each name. Provide the Bayer code for the species [see web site <http://cipm.ncsu.edu/names/index.cfm>]. Include the Latin, English and French names of the family to which the weed belongs.

2. Description and Account of Variation

(a) *Species Description*—Present a short description of the weed, similar to that given in *Weeds of Canada* (Frankton

and Mulligan 1987). Use the metric system for measurements. Where possible, use simple descriptive terms rather than more technical taxonomic terms in describing features (or if no simple term exists explain the taxonomic term in brackets). Include the chromosome number(s), with provincial location of any Canadian material counted, and give the chromosome number range for the species as a whole.

(b) *Distinguishing Features*—Describe morphological characters that distinguish the weed from all other Canadian plants with which it may be confused and consider including a diagnostic key.

(c) *Intraspecific Variation*—Describe any recognizable intraspecific variation in Canadian populations and populations elsewhere [taxonomic, cytological, ecological, genetic (allozyme, molecular data), chemical, etc.].

(d) *Illustrations*—Include a photograph or drawing, or both, of a mature plant, a seedling at approximately the two-leaf stage, and any other stage that persists for some time (for example, the rosette of a biennial). Each of these illustrations should portray clearly any diagnostic characters that would be useful for identification in the field. Important alterations in the appearance of any stage in the life history that results from grazing, mowing, herbicide applications, parasites, diseases, etc., would be useful. List any published illustrations or Internet sites with illustrations, such as the web site of the Weed Science Society of America [<http://www.wssa.net/>].

3. Economic Importance

(a) *Detrimental*—Specify the nature of economic loss resulting from the growth of this species (e.g., competes with crop or pasture species, is toxic or irritant to farm animals or humans, chemically inhibits crop species, makes harvesting difficult, destroys appearance of lawns or gardens, etc.). Is the weed a close relative of crop species grown in Canada or elsewhere, with which it is capable of hybridization (See Section 9)? Does it have herbicide-resistant biotypes (See Section 11)? Does the weed harbour insects or disease organisms that attack other plant species (See Section 13)? Give financial estimates of losses wherever possible.

(b) *Beneficial*—Does the species have an important role as a part of various food chains? Does it bind together soils that are laid bare by fire, construction, farming, etc.? Is it an important genetic resource? Is it a source of honey? Does it have aesthetic value? Is the plant used as a crop or ornamental in Canada or elsewhere?

(b) *Legislation*—Is the species listed in any Canadian Federal or Provincial Weed or Seeds Acts (see web site of the Canadian Weed Science Society: <http://cwss-scm.ca/>)?

4. Geographical Distribution

Give the distribution and abundance in Canada (blank maps for plotting the Canadian distribution can be provid-

ed) and also the extra-Canadian distribution. Computer-based maps of acceptable standard can be used. Smaller scale maps may be used for weed species with a narrower distribution. Supplementary maps may be necessary if there are different biotypes. Note that Nunavut has been created from the eastern portion of the former Northwest Territories. See Holmgren et al. (1990) for herbarium abbreviations; on-line version available at <http://www.nybg.org/bsci/ih/ih.html>.

5. Habitat

(a) *Climatic requirements*—Include the climatic (including microclimatic) limitations and preferences with regard to temperature, rainfall, atmospheric humidity, exposure to wind, etc. Where relevant, give the light intensity and its seasonal variation in relation to the life history and distribution of the species (where measurements are given, the methods used should be mentioned). Any restriction or expansion of distribution caused by low temperatures, flooding, drought or other extremes in climate should be considered.

(b) *Substratum*—Give the characteristics of the soils in various habitats and different parts of the range of the species. If the species occurs in specific habitats or is geographically distributed in a way that suggests specific substrate requirements, identify the soil properties affecting this distribution (textural class, drainage class, soil reaction or profile types). Terminology should conform to that specified in *The Canadian System of Soil Classification* (3rd edition), NRC Research Press (Anonymous 1998).

(b) *Communities in which the species occurs*—Briefly describe the community (e.g., spring wheat fields, corn fields, lawns, waste places, etc.) and give the abundance and frequency of your species in each community. For each community where the species is an important component, list in tabular form the associated plant species and give a history of the habitat (e.g., pasture for 50 years). State whether the weed grows in the open or if it normally grows in the shade of other plants.

6. History

For introductions, give evidence and dates for the first introduction of this species into North America and Canada. Also, give available information on time and rate of spread. Give any information on how the plant was originally introduced (e.g., as an impurity in crop seed, as a cultivated plant, or in ballast). For native species, give a brief account of the history of the species as a natural part of the native flora with notes on the changes in the distribution and abundance of the plant since the time of first European settlement.

7. Growth and Development

(a) *Morphology*—List any morphological characteristics that are of special importance in the colonization and survival of the weed (e.g., underground stems, spines, unpalatable hairs, and hooked seeds) and discuss why these characteristics are of survival value.

(b) *Perennation*—Include the mode of perennation and give a general description of winter conditions.

(c) *Physiological data*—Include transpiration rates, osmotic values, etc., when relevant. Information on a broad range of physiological topics, including mineral nutrition, can also be placed here.

(d) *Phenology*—Give the times of maximal growth of roots and other underground organs; of appearance and growth of leafy shoots (especially for woody species); of flowering; of maturation and shedding of seeds; of germination of seeds or appearance (emergence) of seedlings.

(d) *Mycorrhiza*—State presence or absence of mycorrhiza and, if present, describe.

8. Reproduction

(a) *Floral biology*—Describe the mode of pollination of flowers. List the insect visitors to flowers and describe their behaviour. Are the flowers self-compatible? Are seeds usually produced by autogamy, allogamy, or agamospermy? Is there any evidence of outcrossing in species that can produce seeds autogamously? Does vivipary occur?

(b) *Seed production and dispersal*—What are the average numbers of seeds per fruit, per inflorescence, and per plant? What is the average weight per seed and/or per propagule? Give mode of seed dispersal and special features, if any (e.g., seeds attaching themselves to clothing and fur of animals).

(c) *Seed banks, seed viability and germination*—What is the longevity of seeds in the seed bank? Does the species have a persistent seed bank or only a transient one, and does this differ across the range of the species? Include information on the viability of seeds under different conditions (state how determined). Give geographical location for germination under natural conditions or seed source if under controlled conditions. List any special conditions affecting germination, e.g., sensitivity to light, necessity for preliminary freezing, etc., and conditions for successful establishment of seedlings.

(d) *Vegetative reproduction*—Describe the mode and rate of vegetative reproduction and spread. Describe any vegetatively produced propagules. Give the age of the plant when vegetative reproduction first occurs. State the relative importance of various means of reproduction. Is the reproductive strategy different in different habitats (for example, more seeds in one habitat but more bulbils in a second habitat)?

9. Hybrids

Describe the existence and frequency of natural hybridization with other plants. Is there any evidence of interspecific hybridization between the species and cultivated plants? How can these hybrids be recognized? To what extent do the hybrids show a diminished fertility or increased vigour as compared with the parents? Are the hybrids of any biological or economic significance?

10. Population Dynamics

Give the rate of increase and decline of populations in various habitats (numbers of individual stalks should be given if possible). Include the mean length of life of individuals in various habitats. Do more plants appear or die in certain months or seasons or after certain changes in the habitat (e.g., drought, flooding) or manipulation (e.g., after clipping)? Describe the plant's competitive ability (intraspecific and interspecific) and its method of competing with other plants. Does the species usually occur as solitary plants, large patches, small patches, etc.? Give the number of generations per year, per decade, or perhaps per century. Describe processes of decay and decomposition involving this species, including the names of the organisms involved. Note: seed population dynamics should be discussed in Section 8(c).

11. Response to Herbicides and Other Chemicals

Give the susceptibility of this species to the most widely used herbicides and herbicide combinations at various stages in its life history. Are there any herbicide-resistant biotypes of the weed in Canada and/or elsewhere? Has the composition of the associated flora changed in response to the repeated application of herbicides?

12. Response to Other Human Manipulations

Describe any response by the weed due to mowing, fertilizing chemicals and manure, ploughing, trampling, fallowing, crop rotation, harvesting, integrated pest management, etc.

13. Response to Herbivory, Disease and Higher Plant Parasites

Includes biological control and controlled grazing programs.

(a) *Herbivory*

- (i) Mammals, including both domestic and wild animals
- (ii) Birds and/or other vertebrates
- (iii) Insects
- (iv) Nematodes and/or other non-vertebrates

(b) *Diseases*

- (i) Fungi (e.g., Farr et al. 2002)
- (ii) Bacteria
- (iii) Viruses (e.g., Brunt et al. 1996)

(c) *Higher Plant Parasites*

In each instance, for all subsections listed above, name the organism attacking the weed (provide the Latin name and nomenclatural authority), indicate its host specificity, abundance and distribution. Describe the stage of the plant attacked, type of damage inflicted, response of the plant population, and value of the attacking species for control of the weed.

Note: In each section, place the Canadian (and/or North American) information first. Where possible in each section, indicate whether the study was done in the field or in a greenhouse/growth chamber). For field studies, provide the geographic location where the work was done (province/state, country) or the source of the wild population studied.

For any plant species, provide the Latin name and nomenclatural authority when first mentioned in the text. In general, authors should cite printed materials and limit reference to illustrations/information from internet sites to those sites maintained by a major society or organization.

B. PUBLICATIONS TO DATE

Up to October 2003, 127 papers had been published, many of them dealing with two or more species. There have also been two updated accounts, on *Sinapis arvensis* and *Thlaspi arvense*. Interest in the complete series has resulted in the re-publication of individual contributions 1–32, 33–61, 62–83 and 84–102 in four separate compilations edited by G. A. Mulligan (1979, 1984) and P. B. Cavers (1995, 2000).

Accounts have been published on:

Abutilon theophrasti, *Achillea millefolium*, *Acroptilon* (*Centaurea*) *repens*, *Agropyron* (*Elytrigia*) *repens*, *Alliaria petiolata*, *Amaranthus albus*, *Amaranthus blitoides*, *Amaranthus blitum*, *Amaranthus hybridus*, *Amaranthus powellii*, *Amaranthus retroflexus*, *Ambrosia artemisiifolia*, *Ambrosia psilostachya*, *Ambrosia trifida*, *Anthriscus sylvestris*, *Apera spica-venti*, *Arctium lappa*, *Arctium minus*, *Artemisia absinthium*, *Artemisia vulgaris*, *Asclepias syriaca*, *Atriplex patula*, *Atriplex prostrata*, *Atriplex rosea*, *Avena fatua*, *Barbarea vulgaris*, *Bromus tectorum*, *Cannabis sativa*, *Cardaria chalepensis*, *Cardaria draba*, *Cardaria pubescens*, *Carduus acanthoides*, *Carduus nutans*, *Centaurea diffusa*, *Centaurea maculosa*, *Chenopodium album*, *Cicuta douglasii*, *Cicuta maculata*, *Cicuta virosa*, *Cirsium arvense*, *Comptonia peregrina*, *Convolvulus arvensis*, *Conyza* (*Erigeron*) *canadensis*, *Cornus canadensis*, *Crataegus crus-galli*, *Crepis tectorum*, *Cynoglossum officinale*, *Cyperus esculentus*, *Cytisus scoparius*, *Danthonia spicata*, *Datura stramonium*, *Daucus carota*, *Demnstaedtia punctilobula*, *Descurainea sophia*, *Dipsacus sylvestris* (*fullonum*), *Echinochloa crus-galli*, *Echium vulgare*, *Elodea canadensis*, *Epilobium angustifolium*, *Equisetum arvense*, *Erucastrum gallicum*, *Euphorbia cyparissias*, *Euphorbia esula*, *Fagopyrum tataricum*, *Galeopsis tetrahit*, *Galinsoga parviflora*, *Galinsoga quadriradiata*, *Galium aparine*, *Galium mollugo*, *Galium spurium*, *Gaultheria shallon*, *Gypsophila paniculata*, *Helianthus tuberosus*, *Holcus lanatus*, *Hordeum jubatum*, *Hydrocharis morsus-ranae*, *Hypericum perforatum*, *Hypochoeris radicata*, *Iva axillaris*, *Kalmia angustifolia*, *Lactuca serriola*, *Lappula squarrosa*, *Linaria dalmatica*, *Linaria vulgaris*, *Lotus corniculatus*, *Lythrum salicaria*, *Malva pusilla*, *Matricaria perforata*, *Medicago lupulina*, *Melilotus alba* (*albus*), *Melilotus officinalis*, *Myrica pensylvanica*, *Myriophyllum spicatum*, *Neslia paniculata*, *Oenothera biennis*, *Oxalis corniculata*, *Oxalis dillenii* spp. *dillenii*, *Oxalis dillenii*, ssp. *filipes*, *Oxalis stricta*, *Plantago lanceolata*, *Plantago major*, *Plantago rugelii*, *Poa annua*, *Polygonum convolvulus*, *Portulaca oleracea*, *Potamogeton crispus*, *Potentilla anserina*, *Potentilla argentea*, *Potentilla norvegica*, *Potentilla recta*, *Prunus serotina*, *Prunus virginiana*, *Pteridium aquilinum*, *Pyrus melanocarpa*, *Rhus* (*Toxicodendron*) *radicans*, *Rubus hispidus*, *Rubus parviflorus*, *Rubus spectabilis*, *Rubus strigosus* (*idaeus*), *Salsola pestifer*,

Senecio jacobaea, *Senecio vulgaris*, *Setaria glauca* (*pumila*), *Setaria verticillata*, *Setaria viridis*, *Silene alba* (*pratensis*), *Silene noctiflora*, *Sinapis arvensis* [+update], *Solanum carolinense*, *Solanum nigrum*, *Solanum ptychanthum*, *Solanum rostratum*, *Solanum sarrachoides*, *Solidago canadensis*, *Sonchus arvensis*, *Sonchus asper*, *Sonchus oleracea* (*oleraceus*), *Sorghum halepense*, *Spiraea latifolia* (*alba*), *Stellaria media*, *Symphyotrichum* (*Aster*) *ericoides*, *Symphyotrichum* (*Aster*) *lanceolatum*, *Symphyotrichum* (*Aster*) *lateriflorum*, *Symphyotrichum* (*Aster*) *novae-angliae*, *Symphyotrichum* (*Aster*) *pilosum*, *Taraxacum officinale*, *Thlaspi arvense* [+update], *Tragopogon dubius*, *Tragopogon porrifolius*, *Tragopogon pratensis*, *Trifolium repens*, *Typha angustifolia*, *Typha latifolia*, *Typha xglauca*, *Ulex europeus*, *Urtica dioica*, *Vallisneria americana*, *Veratrum viride*, *Verbascum blattaria*, *Verbascum thapsus*, *Vicia angustifolia*, *Vicia cracca*, *Vicia sativa*, *Vicia tetrasperma*, *Vicia villosa*, *Viola arvensis*, *Xanthium strumarium*.

C. MANUSCRIPTS IN PREPARATION

(Includes several submissions under review)

Acer negundo, *Agrostis scabra* (*A. hiemalis*), *Alliaria petiolata* [update], *Amaranthus hybridus* [update], *Amaranthus powellii* [update], *Amaranthus retroflexus* [update], *Apera interrupta*, *Apocynum cannabinum*, *Artemisia biennis*, *Astragalus miser*, *Bidens cernuus*, *Bidens frondosus*, *Bidens tripartitus*, *Bidens vulgatus*, *Bromus inermis*, *Bromus japonicus*, *Butomus umbellatus*, *Calamagrostis canadensis*, *Capsella bursa-pastoris*, *Cerastium arvense*, *Cerastium vulgatum*, *Chenopodium album* [update], *Cirsium vulgare*, *Cornus canadensis* [update], *Coronopus didymus*, *Cynanchum* (*Vincetoxicum*) *louiseae*, *Cynanchum* (*Vincetoxicum*) *rossicum*, *Daphne laureola*, *Digitaria ischaemum*, *Digitaria sanguinalis*, *Erysimum cheiranthoides*, *Galinsoga parviflora* [update], *Galinsoga quadriradiata* [update], *Glechoma hederacea*, *Glyceria maxima*, *Hedera helix*, *Hieracium aurantiacum*, *Hieracium pilosella*, *Hieracium pratense*, *Hordeum vulgare*, *Kochia scoparia*, *Lepidium* spp., *Leucanthemum* (*Chrysanthemum*) *vulgare*, *Lonicera* spp., *Mentha arvensis*, *Mollugo verticillata*, *Muhlenbergia frondosa*, *Onopordum acanthium*, *Panicum capillare*, *Panicum miliaceum*, *Pastinaca sativa*, *Phalaris arundinacea*, *Phragmites australis*, *Polygonum aviculare*, *Polygonum coccineum*, *Polygonum lapathifolium*, *Polygonum pensylvanicum*, *Polygonum perforatum*, *Polygonum persicaria*, *Polygonum scabrum*, *Raphanus raphanistrum*, *Ranunculus acris*, *Rhamnus catharticus*, *Rhamnus frangula*, *Rhus glabra*, *Rhus typhina*, *Robinia pseudoacacia*, *Rosa multiflora*, *Rumex crispus*, *Rumex obtusifolius*, *Saponaria officinalis*, *Setaria faberi*, *Silene vulgaris*, *Solanum triflorum*, *Spergula arvensis*, *Stachys palustris*, *Tanacetum vulgare*, *Tussilago farfara*, *Veronica* spp.

D. UPDATED ACCOUNTS

Where there has been a substantial amount of new information published on a weed species after the publication of its initial treatment in the biology of Canadian weeds series, then an updated account on that species is warranted. There must have been a minimum of 20 years since the publication of the original account before the update can be published. The aim

of such accounts should be to augment the original publication, rather than to produce an entirely new manuscript. Please consult with the CWSS committee (Dr. Cavers) if you wish to prepare an updated account.

E. FORMAT FOR UPDATED ACCOUNTS

The number of the account will be the same as the original (e.g., The biology of Canadian weeds. 8. *Sinapis arvensis* L. (updated). At the beginning of each updated account (before Section 1) the following sentence should appear:

“This account is an update of the original paper by [name(s)] (date) published in the Canadian Journal of Plant Science (Volume) (page numbers).”

Section 1 Name, Section 2 (a)–(d) inclusive and part of Section 4 (Map of Canadian distribution), should be repeated in full in the revised account.

The remaining sections (3 to 13 inclusive) should only include information that was not included in the original account. However, minimal repetition may be needed to provide a contextual framework for new data.

F. ACKNOWLEDGEMENTS

The authors wish to thank Stephen Darbyshire, Agriculture and Agri-Food Canada, Ottawa for comments on the manuscript.

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PART IV. A NEW SERIES—THE BIOLOGY OF INVASIVE ALIEN PLANTS IN CANADA

Instructions for Preparation of Accounts

S. I. Warwick¹, P. B. Cavers², and S. Darbyshire¹

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The term “invasive alien plants in Canada” as used in this series, refers to any vascular plant that has recently been introduced to Canada, has a history of invasiveness and/or weediness in other parts of its range, and/or has characteristics that indicate a potential to establish, proliferate, spread and cause broadly defined detrimental consequences in Canadian ecosystems (including agro-ecosystems). The series will form a companion to the Biology of Canadian Weeds (BCW) series initiated in 1972 (Cavers and Mulligan 1972; Cavers and Warwick 2000) and for which 127 accounts have been published to date (see Cavers et al. 2003). The new series is designed to draw attention to the issue of invasive plants and their impact in both natural ecosystems and agro-ecosystems.

Globalization of trade, with concomitant elaboration of transportation systems and increasing commodity diversity and volume, has increased the rate of introduction of invasive alien plants. Once established in Canada, they may cause export market loss and/or commodity devaluation, jeopardize native biodiversity and habitats through severe competition or displacement, and threaten environmental health through toxicity and/or increased herbicide use (White et al. 1993; Claudi et al. 2002). A conservative estimate of direct annual losses to major crop production alone was about a billion dollars in Canada in the early 1990s (Swanton et al. 1993). Pimentel et al. (2000) estimated the annual cost of invasive plants to the U.S. economy at about \$40 billion. Of this total, \$26.4 billion was attributed to cropland weeds, primarily through crop losses and damage. Darbyshire (2002) estimated that one to two new alien plant species are becoming established in Canada every year and that the rate will increase. Regulations, legislation, and enforcement concerning invasive alien plants occur at international, federal and provincial levels. There is a need for information to assist with early detection and accurate identification of new infestations as well as diagnosis of their potential for detrimental effects. The purpose of this new series will be to bring together published and unpublished information on the biology of these invasive alien plants, which will not only serve as an alert of emerging problems but can also be utilized as a basis for developing effective, economical and safe control methods. It is also intended that the series will engender research that will fill important gaps in our knowledge of the biology of these species, including: effective eradication, quarantine and/or management strate-

gies; detection of divergent genetic variation in species complexes; and, important life cycle information such as reproductive strategies, dispersal and population dynamics. The establishment of such a series was one of the key recommendations of a recent Committee on the Scientific Basis for Predicting the Invasive Potential of Nonindigenous Plants and Plant Pests in the United States [“Recommendation 5. A literature synthesis on the natural history of potential immigrant species, similar to the Biology of Canadian Weeds series published by the Canadian Journal of Plant Science, should be established, standardized and made accessible via the Internet”] (Anonymous 2002).

If you wish to write an account on an invasive alien plant species, you must first check that the species has not been assigned to someone else. This involves sending an “offer of contribution” to Dr. Warwick. After approval of your offer you may proceed with writing the paper. The completed paper is to be submitted directly to the Canadian Journal of Plant Science (see below).

Offers of contribution by individuals or groups should be made to Dr. Suzanne I. Warwick, Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Neatby Building, Central Experimental Farm, Ottawa, Ontario, Canada K1A 0C6, e-mail warwicks@agr.gc.ca. Suzanne Warwick and Stephen Darbyshire will serve as co-editors of the series. Contributions will be subject to approval by a committee set up by the Canadian Weed Science Society (CWSS). Potential authors should provide some evidence that the weed species is either established in Canada, or has been introduced and has the potential to establish in Canada. Approved submissions will be subject to re-approval after two years if the article has not been completed during that period. Any inquiries about the format to be used or advice on preliminary drafts should be directed to Dr. Warwick. She can also supply blank maps (or a pdf file) of Canada and will suggest specialists or institutions that will provide various types of services for authors. The Canadian Weed Science Society has a web site (<http://cwss-scm.ca/>) with on-line references to common English and French names of many weed species, links to provincial and federal legislation and current lists of species published and in preparation for the Biology of Canadian Weeds series and this new series.

Authors should consider carefully the status and history of the species in Canada in selecting the appropriate series.

The Biology of Canadian Weeds series addresses undeniable problematic weeds in Canada, whereas the new Biology of Invasive Alien Plants series is designed to cover aliens in Canada that have demonstrable potential risk. As well as dealing with economic detriment, this series will also provide a strong emphasis on species causing problems to environmental health. The following are criteria for inclusion in the invasive alien series: “established aliens with potential for becoming invasive or weedy”, “aliens showing recent rapid expansion of geographic and/or habitat range in Canada”, and “established aliens showing invasive or weedy characteristics and/or patterns in other areas of the world with similar climatic conditions to Canada”. A number of species considered to be important invasives have already been dealt with under the Biology of Canadian Weeds series; potential authors should review the list of species covered under that series (Cavers et al. 2003). Most accounts will deal with a single species but some may logically describe two or more closely related species. All native species that are considered invasive will be covered under the Biology of Canadian Weeds series. In cases where the assignment to a particular series is not clear, the editors of both series may be called upon to make a judgement call. The new series will stress control-related aspects and requires more extensive coverage in some areas such as identification, occurrence, impact and prognosis and less extensive coverage in other areas of biology. In some cases, relatively little published information will be available for review, resulting in a short article. Nevertheless, such contributions are essential for early detection and management.

Finished manuscripts should be submitted to: Canadian Journal of Plant Science; Mr. T. Fenton, Head, Journals Section, Agricultural Institute of Canada, 141 Laurier Ave. W., Suite 1112, Ottawa, Ontario, Canada K1P 5J3. All contributions must comply with the format of this journal. Accounts, including all maps, drawings, diagrams and photographs, should not exceed 50 pages (12 point font, double-spaced with numbered lines). The authors are encouraged to provide the names and addresses (including phone numbers and e-mails if available) of three potential referees.

The following format is meant as a guide for the types of information to be included and arrangement of the accounts. Since many invasive alien plants have only recently been identified as problems, information in some fields may be sketchy or altogether lacking. Of the 14 topics listed in the outline below: 1 to 6 and 14 are essential and must be covered in substantial depth, and the rest may be covered in less detail. Inclusion of a dichotomous key for identification and a distribution map based entirely on examined herbarium specimens is strongly advised.

A. FORMAT

TITLE: Each account will be given a number when it is accepted for publication. The number will be part of the title and precede the species name, e.g., The Biology of Invasive Alien Plants in Canada. 1. *Eriochloa villosa* (Thunb.) Kunth.

1. Species Name and Taxonomic Relationships

Give the scientific name (genus, species, and nomenclatural authority) currently accepted by plant taxonomists and synonyms that are or have been commonly used. Include English and French vernacular names (if available) of the species in *Common and botanical names of weeds in Canada* (Darbyshire et al. 2000) or other major references. Include a source citation for each name. Provide the Bayer code for the species if available (see web site <http://cipm.ncsu.edu/names/index.cfm>). Include also the Latin, English, and French names of the family to which the species belongs.

Provide information about the genus including: numbers of species world-wide, in North America and Canada; whether they are native or introduced to North America; and if any of the other introduced species are weeds. Any species or genus level taxonomic controversy should be outlined/discussed.

2. Description and Account of Variation

(a) *Species Description*—Present a short description of the invasive alien, similar to that given in *Weeds of Canada* (Frankton and Mulligan 1987) or the Biology of Canadian Weeds series. Use the metric system for measurements. Where possible, use simple descriptive terms rather than more technical taxonomic terms in describing features (or if no simple term exists explain the taxonomic term in brackets). Include the chromosome number(s) with provincial location of any Canadian material counted, and give the chromosome number range for the species as a whole.

(b) *Distinguishing Features*—Describe morphological characters that distinguish the invasive alien from all other Canadian plants with which it may be confused and include a diagnostic key (either in the text or as an Appendix).

(c) *Intraspecific Variation*—Describe any recognizable intraspecific variation in Canadian populations and populations elsewhere [taxonomic, cytological, ecological, genetic (allozyme, molecular data), chemical, etc.].

(d) *Illustrations*—Include a photograph or drawing, or both, of a mature plant, a seedling at approximately the two-leaf stage, and any other stage that persists for some time (for example, the rosette of a biennial). Each of these illustrations should portray clearly any diagnostic characters that would be useful for identification in the field. Important alterations in the appearance of any stage in the life history that results from grazing, mowing, herbicide applications, parasites, diseases, etc., would be useful. List any published illustrations or Internet sites with illustrations, such as the web site of the Weed Science Society of America (<http://www.wssa.net>).

3. Economic Importance and Environmental Impact

(a) *Detrimental*—Specify the nature of loss or costs to native biodiversity of natural ecosystems or to agricultural systems, industry and human health resulting from the growth of this species (e.g., eliminates native plant associations,

reduces native genetic diversity through hybridization, competes with crop or pasture species, is toxic or irritant to farm animals or humans, chemically inhibits crop species, makes harvesting difficult, affects lawns or garden appearance, etc.). Is the invasive alien a close relative of species growing in Canada or elsewhere, with which it is capable of hybridization (See Section 9)? Does it have herbicide-resistant biotypes (See Section 11)? Does the invasive alien harbour insects or disease organisms that attack other plant species (See Section 13)? Give financial estimates of losses wherever possible. Does the invasive alien have, or is it expected to have, an environmental impact? Is the invasive alien able to establish populations in natural habitats and successfully compete with or exclude native species?

(b) *Beneficial*—Does the invasive alien have an important role as a part of various food chains? Does it bind together soils that are laid bare by fire, construction, farming, etc.? Is it an important genetic resource? Is it a source of honey? Does it have aesthetic value? Is the plant used as a crop plant, nursery plant, or ornamental in Canada or elsewhere? Does it or has it ever had any economic importance?

(c) *Legislation*—Is the invasive alien listed in any Canadian federal or provincial legislation or subject to quarantine regulations provincially, nationally or internationally (see web site of the Canadian Weed Science Society: <http://cwss-scm.ca/>)?

4. Geographical Distribution

Give the distribution and abundance in Canada, North America and then its global distribution. Blank maps for plotting the Canadian distribution can be provided. If the weed is not yet widespread in Canada, it may be advisable to provide a map of the current U.S. distribution. Computer-based maps of acceptable standard can be used. Smaller scale maps may be used for species with a narrower distribution. Supplementary maps may be necessary if there are different biotypes or to show patterns of invasion over time. Maps should be based on examined and verified herbarium specimens to the extent possible; site records are also acceptable. See Holmgren et al. (1990) for herbarium abbreviations; on-line version available at <http://www.nybg.org/bsci/ih/ih.html>.

5. Habitat

(a) *Climatic Requirements*—Include the climatic (including microclimatic) limitations and preferences with regard to temperature, rainfall, atmospheric humidity, exposure to wind, etc. Where relevant, give the light intensity and its seasonal variation in relation to the life history and distribution of the species (where measurements are given, the methods used should be mentioned). Any restriction or expansion of distribution caused by low temperatures, flooding, drought or other extremes in climate should be considered.

(b) *Substratum*—Give the characteristics of the soils in various habitats and different parts of the range of the species. If the species occurs in specific habitats or is geographically distributed in a way that suggests specific substrate requirements, identify the soil properties affecting this dis-

tribution (textural class, drainage class, soil reaction or profile types). Terminology should conform to that specified in *The Canadian System of Soil Classification* (3rd edition), NRC Research Press (Anonymous 1998).

(c) *Communities in which the species occurs*—Briefly describe the community (e.g., spring wheat fields, corn fields, lawns, waste places, forests [coniferous, deciduous or mixed, plantations), wetlands (bogs, fens, swamps, marshes, shallow open water), native prairie, etc.] and give the abundance and frequency of the species in each community. For each community where the species is an important component, list in tabular form the associated plants and give a history of the habitat (e.g., pasture for 50 years). State whether the invasive alien grows in the open or if it normally grows in the shade of other plants.

6. History

Provide evidence and dates for the first introduction of the species into North America and Canada. Also, give available information on date of subsequent introductions, persistence and rate of spread. Give any information on how the plant was originally introduced (e.g., as an impurity in crop seed, as a cultivated or ornamental plant, or in ballast).

7. Growth and Development

(a) *Morphology*—List any morphological characteristics that are of special importance in the colonization, invasiveness and survival of the species (e.g., underground stems, spines, unpalatable hairs, and hooked seeds) and discuss why these characteristics are of survival value. Indicate “new” attributes that make the species especially invasive in its new habitat (e.g., change in breeding system, dormancy or germination requirements, seed shattering, etc.)

(b) *Perennation*—Include the mode of perennation and give a general description of winter conditions.

(c) *Physiological data*—Include transpiration rates, osmotic values, etc., when relevant. Information on a broad range of physiological topics, including mineral nutrition, can also be placed here.

(d) *Phenology*—Give the times of maximal growth of roots and other underground organs; of appearance and growth of leafy shoots (especially for woody species); of flowering; of maturation and shedding of seeds; of germination of seeds or appearance (emergence) of seedlings.

(e) *Mycorrhiza*—State presence or absence of mycorrhiza and, if present, describe.

8. Reproduction

(a) *Floral biology*—Describe the mode of pollination of flowers. List the insect visitors to flowers and describe their behaviour. Are the flowers self-compatible? Are seeds usually produced by autogamy, allogamy, or agamospermy? Is there any evidence of outcrossing in species that can produce seeds autogamously? Does vivipary occur?

(b) *Seed production and dispersal*—What are the average numbers of seeds per fruit, per inflorescence, and per plant? What is the average weight per seed and/or per propagule? Give mode of seed dispersal and special features, if any (e.g., seeds attaching themselves to clothing and fur of animals).

(c) *Seed banks, seed viability and germination*—What is the longevity of seeds in the seed bank? Does the species have a persistent seed bank or only a transient one, and does this differ across the range of the species? Include information on the viability of seeds under different conditions (state how determined). Give geographical location for data on germination under natural conditions or seed source if under controlled conditions. List any special conditions affecting germination, e.g., sensitivity to light, necessity for preliminary freezing, etc., and conditions for successful establishment of seedlings.

(d) *Vegetative reproduction* – Describe the mode and rate of vegetative reproduction and spread. Describe any vegetatively produced propagules. Give the age of the plant when vegetative reproduction first occurs. State the relative importance of various means of reproduction. Is the reproductive strategy different in different habitats (e.g., more seeds in one habitat but more bulbils in a second habitat)?

9. Hybrids

Describe the existence and frequency of natural hybridization with other plants. Is there any evidence of interspecific hybridization between the species and cultivated plants? How can these hybrids be recognized? To what extent do the hybrids show a diminished fertility or increased vigour as compared with the parents? Are the hybrids of any biological or economic significance?

10. Population Dynamics

Give the rate of increase and decline of populations in various habitats (numbers of individual stalks should be given if possible). Include the mean length of life of individuals in various habitats. Do more plants appear or die in certain months or seasons or after certain changes in the habitat (e.g., drought, flooding) or manipulation (e.g., after clipping)? Describe the plant's competitive ability (intraspecific and interspecific) and its method of competing with other plants. Does the species usually occur as solitary plants, large patches, small patches, etc.? Give the number of generations per year, per decade, or perhaps per century.

Note: seed population dynamics should be discussed in Section 8c.

11. Response to Herbicides and Other Chemicals

Give the susceptibility of this species to the most widely used herbicides and herbicide combinations at various stages in its life history. If applicable, provide a brief list of herbicides of potential use for control, including those that may not be registered in Canada. Are there any herbicide-resistant biotypes of the species in Canada and/or else-

where? Has the composition of the associated flora changed in response to the repeated application of herbicides?

12. Response to Other Human Manipulations

Describe any response by the invasive alien to mowing, fertilizing chemicals and manure, ploughing, trampling, fallowing, crop rotation, harvesting, integrated pest management, etc.

13. Response to Herbivory, Disease and Higher Plant Parasites

Includes biological control and controlled grazing programs.

(a) *Herbivory*

- (i) Mammals, including both domestic and wild animals
- (ii) Birds and/or other vertebrates
- (iii) Insects
- (iv) Nematodes and/or other non-vertebrates

(b) *Diseases*

- (i) Fungi (e.g., Farr et al. 2002)
- (ii) Bacteria
- (iii) Viruses (e.g., Brunt et al. 1996)

(c) *Higher Plant Parasites*

In each instance for all subsections listed above, name the organism attacking the invasive alien (provide the Latin name and nomenclatural authority), indicate its host specificity, abundance and distribution. Describe the stage of the plant attacked, type of damage inflicted, response of the plant population, and value of the attacking species for control of the invasive alien.

14. Prognosis

Assess the degree to which the invasion of this species poses a threat to Canada. Indicate measures needed for curbing the invasion and/or eradicating the species. Where appropriate, describe the experience of other jurisdictions in dealing with invasion by the weed, and strategies employed elsewhere to attempt to halt its spread.

Note: In each section, place the Canadian (and/or North American) information first. Where possible in each section, indicate whether the study was done in the field or in a greenhouse/growth chamber. For field studies, provide the geographic location where the work was done (province/state, country) or the source of the wild population studied. For any plant species, provide the Latin name and nomenclatural authority when first mentioned in the text. In general, authors should cite printed materials and limit reference to illustrations/information from internet sites to those sites maintained by a major society or organization.

B. ACKNOWLEDGEMENTS

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