

The Biology of Canadian Weeds. Revised format and instructions for preparation of updated accounts

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Over the past 27 years the Canadian Journal of Plant Science has been publishing accounts on the biology of plants that are weedy in Canada. The series resulted from a recommendation by the Canada Weed Committee, now known as the Expert Committee on Weeds. The purpose was to bring together published and unpublished information on the biology of Canadian weeds, which could be utilized as a basis for effective economical and safe weed control methods and meet the needs of regulatory agencies in Canada. It was also intended that the series would result in research that would fill important gaps in our knowledge of the biology of these weeds. An article by Cavers and Mulligan entitled "A New Series – The Biology of Canadian Weeds" appeared in the Canadian Journal of Plant Science in July 1972 and it provided a detailed format for the series. Over 110 accounts have been published to date.

With the passage of time, there has been a recognized need for an updated format for the series especially to allow for access to other information media that have become available. In addition, much new information has been published since the first accounts in this series appeared; hence there is a need for updated accounts on certain species.

The term "weed," as used in this series, refers to any vascular plant that perpetuates itself in habitats where it is not wanted. Contributions should contain accounts of a single weed species or a group of related species. Offers of contributions by individuals or groups should be made to Dr. P. B. Cavers, Department of Plant Sciences, University of Western Ontario, London, Ontario, N6A 5B7, e-mail pcavers@julian.uwo.ca. These offers of contributions will be subject to approval by a committee set up by the Expert Committee on Weeds, Canada. Approved offers will be subject to re-approval after 3 years. Any inquiries about the format to be used or advice on preliminary drafts should be directed to Dr. Cavers. He will also supply blank maps of Canada and will suggest specialists or institutions that will provide various types of services. The Expert Committee on Weeds (ECW) has initiated a new web site and in the near future authors should find 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, 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 15 printed journal pages. Of course, accounts on more than one species can be longer.

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. 1. *Agropyron repens* (L.) Beauv.

1. Name

Give the scientific name (genus, species, and authority) currently accepted by plant taxonomists and synonyms that are used in weed literature. Include also the Latin, English, and French names of the family to which the weed belongs, and also the recommended English and French vernacular names of the weed that are given in *Common and botanical names of weeds in Canada* (2nd edition, Mulligan 1992).

2. Description and Account of Variation

(a) Present a short description of the weed, similar to that given in *Weeds of Canada* (Frankton and Mulligan 1987), but use the metric system for measurements. Include the chromosome number(s), including provincial location obtained from Canadian material and give the chromosome number range for the species as a whole. (b) Give morphological characters that distinguish the weed from all other Canadian plants with which it may be confused. (c) Describe any recognizable intra-specific variation in Canadian populations and populations elsewhere (taxonomic, cytological, ecological, genetic, allozyme, molecular, chemical, etc.). (d) 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 Internet sites with illustrations, such as [<http://www.weed.science.com/>].

3. Economic Importance

(a) *Detrimental* – Specify 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? Does it have herbicide-resistant biotypes (See Section 11)? Does the weed harbour insects or disease organisms that attack other plant species? 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 plant, nurse plant, or ornamental in Canada or elsewhere? (c) *Legislation* – Is the species listed in any Canadian Federal or Provincial Weed or Seeds Acts? (see ECW website).

4. Geographical Distribution

Give the distribution and abundance in Canada (blank maps for plotting the Canadian distribution can be provided) and also the distribution outside of Canada. Computer-based maps of acceptable standard can be used. Smaller scale maps may be used for weed species with a narrower distribution.

5. Habitat

(a) *Climatic requirements* – Include the climatic (including microclimatic) limitations and preferences with regard to temperature, rainfall, exposure to wind, etc. Give the elevational limits. 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 ed.), NRC Research Press 1998. (c) *Communities in which the species occurs* – Briefly describe the community (e.g., spring wheat fields, corn (maize) 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 associat-

ed plants and give a history of the habitat (e.g., pasture for 50 years). If possible, the list should include characteristic species of groups other than flowering plants (e.g., other plants, animals and microorganisms). 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 when first introduced 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 (for example, 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 photosynthetic and transpiration rates, osmotic values, etc., when relevant. (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 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? 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* – Is there a seed bank? If so, is it transient or persistent? Give details of changes in the seed bank that occur on a seasonal or annual basis. Give information on the viability of seeds under different conditions (state how determined). Where do seeds germinate under natural conditions? List any special conditions affecting dormancy and/or 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. 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 hybrids between wild species. Is there any evidence of interspecific hybridization between the weed and other plants, particularly cultivated plants? How can these hybrids be recognized? To what extent do the hybrids show a diminished fertility 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 (individual stalks should be counted 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., after clipping)? Describe the plant's competitive ability and its method of competing with other plants. Does the plant usually form solitary plants, large patches, small patches, etc.? Give the number of generations per year, per decade, or perhaps per century.

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.

Herbivory: (a) Mammals, including both domestic and wild animals; (b) Birds and/or other vertebrates; (c) Insects; (d) Nematodes and/or other non-vertebrates.

Diseases: (a) Fungi [Reference: Ginns (1986)]; (b) Bacteria; (c) Viruses.

Higher plant parasites: In each instance, name the organism attacking the weed or for which the weed is an alternate host (provide the scientific 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.

ACKNOWLEDGEMENTS

The authors thank S. Darbyshire and A. G. Thomas for their suggestions and constructive criticisms of the format.

Anonymous. 1998. The Canadian System of Soil Classification. 3rd ed. NRC Research Press, Ottawa, ON. 188 pp.

Cavers, P. B. (Ed.) 1995. The biology of Canadian weeds. Contributions 62–83. Agricultural Institute of Canada, Ottawa, ON. 338 pp.

Cavers, P. B. and Mulligan, G. A. 1972. A new series – the biology of Canadian weeds. Can. J. Plant Sci. 52: 651–654.

Frankton, C. and Mulligan, G. A. 1987. Weeds of Canada (revised). Publication 948. Ministry of Supply and Services Canada. NC Press Limited, Toronto, ON. 217 pp.

Ginns, J. H. 1986. Compendium of plant disease and decay fungi in Canada 1960–1980. Publication 1813. Agriculture Canada, Canadian Government Publishing Centre, Ottawa, ON. 416 pp.

Mulligan, G. A. (Ed.) 1979. The biology of Canadian weeds. Contributions 1–32. Publication 1693. Agriculture Canada, Ottawa, ON. 380 pp.

Mulligan, G. A. (Ed.) 1984. The biology of Canadian weeds. Contributions 62–83. Agricultural Institute of Canada, Ottawa, ON. 338 pp.

Mulligan, G. A. 1992. Common and botanical names of weeds in Canada. 2nd ed. Publication 1397. Canada Department of Agriculture, Ottawa, ON.

PUBLICATIONS TO DATE

Up to April 1999, 110 papers had been published, many of them dealing with two or more species. Interest in the complete series resulted in the re-publication of individual contributions 1–32, 33–61 and 62–83 in three separate compilations edited by G. A. Mulligan (1979, 1984) and P. B. Cavers (1995), respectively.

Accounts have been published on:

Abutilon theophrasti, *Achillea millefolium*, *Acroptilon (Centaurea) repens*, *Agropyron repens*, *Alliaria petiolata*, *Amaranthus hybridus*, *Amaranthus powellii*, *Amaranthus retroflexus*, *Ambrosia artemisiifolia*, *Ambrosia psilostachya*, *Ambrosia trifida*, *Anthriscus sylvestris*, *Apera spica-venti*, *Arctium lappa*, *Arctium minus*, *Artemisia absinthium*, *Asclepias syriaca*, *Atriplex patula*, *Atriplex prostrata*, *Atriplex rosea*, *Avena fatua*, *Barbarea vulgaris*, *Bromus tectorum*, *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*, *Cornus canadensis*, *Crataegus crus-galli*, *Crepis tectorum*, *Cynoglossum officinale*, *Cyperus esculentus*, *Cytisus scoparius*, *Danthonia spicata*, *Datura stramonium*, *Daucus carota*, *Dennstaedtia punctilobula*, *Descurainia sophia*, *Dipsacus sylvestris*, *Echinochloa crus-galli*, *Elodea canadensis*, *Epilobium angustifolium*, *Equisetum arvense*, *Erucastrum gallicum*, *Euphorbia cyparissias*, *Euphorbia esula*, *Fagopyrum tataricum*, *Galeopsis tetrahit*, *Galinsoga parviflora*, *Galinsoga quadriradiata*, *Galium aparine*, *Galium spurium*, *Gaultheria shallon*, *Gypsophila paniculata*, *Helianthus tuberosus*, *Holcus lanatus*, *Hordeum jubatum*, *Hypericum perforatum*, *Hypochoeris radicata*, *Iva axillaris*, *Kalmia angustifolia*, *Lappula squarrosa*, *Linaria dalmatia*, *Linaria vulgaris*, *Lotus corniculatus*, *Lythrum salicaria*, *Malva pusilla*, *Matricaria perforata*, *Medicago lupulina*, *Melilotus alba*,

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Melilotus officinalis, *Myrica pensylvanica*, *Myriophyllum spicatum*, *Oenothera biennis*, *Oxalis corniculata*, *Oxalis dillenii* ssp. *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 radicans*, *Rubus hispidus*, *Rubus parviflorus*, *Rubus spectabilis*, *Rubus strigosus*, *Salsola pestifer*, *Senecio jacobaea*, *Setaria glauca*, *Setaria verticillata*, *Setaria viridis*, *Silene alba*, *Silene noctiflora*, *Sinapis arvensis*, *Solanum carolinense*, *Solanum nigrum*, *Solanum ptycanthum*, *Solanum rostratum*, *Solanum sarrachoides*, *Solidago canadensis*, *Sonchus arvensis*, *Sonchus asper*, *Sonchus oleracea*, *Sorghum halepense*, *Spiraea latifolia*, *Stellaria media*, *Thlaspi arvense*, *Tragopogon dubius*, *Tragopogon porrifolius*, *Tragopogon pratensis*, *Trifolium repens*, *Typha angustifolia*, *Typha latifolia*, *Typha xglauca*, *Urtica dioica*, *Vallisneria americana*, *Veratrum viride*, *Verbascum blattaria*, *Verbascum thapsus*, *Vicia angustifolia*, *Vicia cracca*, *Vicia sativa*, *Vicia tetrasperma*, *Vicia villosa*, *Viola arvensis*, *Xanthium strumarium*.

MANUSCRIPTS IN PREPARATION

Apera interrupta, *Aster ericoides*, *Aster lanceolatus*, *Aster lateriflorus*, *Aster novae-angliae*, *Aster pilosus*, *Bidens cernua*, *Bidens frondosa*, *Bidens tripartita*, *Bidens vulgata*, *Bromus japonicus*, *Cannabis sativa*, *Capsella bursa-pastoris*, *Chrysanthemum leucanthemum*, *Cirsium vulgare*, *Digitaria sanguinalis*, *Echium vulgare*, *Erigeron canadensis*, *Glechoma hederacea*, *Hieracium aurantiacum*, *Hieracium pilosella*, *Hieracium pratense*, *Hydrocharis morsus-ranae*, *Kochia scoparia*, *Lepidium* spp., *Lonicera* spp., *Mentha arvensis*, *Mollugo verticillata*, *Muhlenbergia frondosa*, *Neslia paniculata*, *Onopordum acanthium*, *Panicum capillare*, *Panicum miliaceum*, *Phragmites australis*, *Polygonum coccineum*, *Polygonum lapathifolium*, *Polygonum pensylvanicum*, *Polygonum persicaria*, *Polygonum scabrum*, *Ranunculus acris*, *Rhamnus catharticus*, *Rhamnus frangula*, *Rhus glabra*, *Rhus typhina*, *Robinia pseudoacacia*, *Rumex crispus*, *Rumex obtusifolius*, *Saponaria officinalis*, *Senecio vulgaris*, *Silene vulgaris*, *Solanum triflorum*, *Stachys palustris*, *Tanacetum vulgare*, *Taraxacum officinale*, *Tussilago farfara*, *Ulex europaeus*.

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

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).”

(e.g., This account is an update of the original paper by Mulligan and Bailey (1975) published in the Canadian Journal of Plant Science **55**: 171–183).

Section 1. Name. This section should be repeated in full in the revised account.

Sections 2 to 13 inclusive. These 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.

Maps: If the distribution of the species is essentially the same as it was at the date of publication of the original account, then a new map of Canadian distribution is not required. Any changes can be described in one or two sentences. However, if there has been recent expansion of the species or there are extensive changes to the range then a new map should be provided.