



Animal and Plant Health Inspection Service  
U.S. DEPARTMENT OF AGRICULTURE

# **Technical Advisory Group for Biological Control Agents of Weeds Manual**

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of any individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs). Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW., Washington, DC 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

The opinions expressed by individuals in this report do not necessarily represent the policies of the U.S. Department of Agriculture.

# Contents

**Figures** *LOF-1-1*

**Tables** *LOT-1-1*

**Introduction** *1-1-1*

**Technical Advisory Group** *2-1-1*

*Introduction* *2-1-1*

*Charter* *2-2-1*

*Agencies and Organizations' Perspectives* *2-3-1*

*TAG-BCAW Chair's Perspective* *2-4-1*

**Petitions and Permitting** *3-1-1*

*TAG-BCAW Flow Chart for Petitions for Field Release and Test Plant*

*Lists* *3-1-1*

*APHIS Permitting Process* *3-2-1*

**Biological Control of Weeds** *4-1-1*

*Introduction* *4-1-1*

*Identification and Characterization of Agents* *4-2-1*

*Host Specificity Testing of Arthropods* *4-3-1*

*Host Specificity Testing of Pathogens* *4-4-1*

**Format and Evaluation** *5-1-1*

*Petitions for Field Release Format* *5-1-1*

*Petitions for Field Release Evaluation* *5-2-1*

*Test Plant List Format* *5-3-1*

**ESA Compliance** *6-1-1*

*Section 7 Consultations* *6-1-1*

*Biological Assessments and Effects Determination* *6-2-1*

**TAG-BCAW Membership** *A-1-1*

*Directory* *A-1-1*

**Forms** *B-1-1*

**NAPPO Standard**    *C-1-1*

**Fish and Wildlife Service Offices**    *D-1-1*  
*Directory*    *D-1-1*

**Plant Classification System**    *E-1-1*

**References**    *F-1-1*

**Glossary**    *Glossary-1-1*

**Index**    *Index-1-1*

# Figures

- Figure 3-1-1 TAG-BCAW Petition for Field Release or Test Plant List Flow Chart *3-1-2*
- Figure B-1-1 Technical Advisory Group (TAG-BCAW) Reviewer's Comment Sheet - Petition for Field Release of Biological Control Agents of Weeds (front) *B-1-2*
- Figure B-1-2 Technical Advisory Group (TAG-BCAW) Reviewer's Comment Sheet - Petition for Field Release of Biological Control Agents of Weeds (back) *B-1-3*
- Figure B-1-3 TAG-BCAW Reviewer's Comment Sheet for Test Host Plant Lists for Proposed Biological Control Agents of Weeds (front) *B-1-5*
- Figure B-1-4 TAG-BCAW Reviewer's Comment Sheet for Test Host Plant Lists for Biological Control Agents of Weeds (back) *B-1-6*
- Figure B-1-5 PPQ Form 526, Application to Move Live Plant Pets or Noxious Weeds *B-1-9*
- Figure B-1-6 Example of PPQ Form 599, Import Label for Living Regulated Organisms (red and white shipping label) (adhesive label issued before September 9, 2014, but valid until expiration date on permit) *B-1-11*

## Figures

---

# Tables

Table 1-1-1	Where to Report Problems With or Suggestions for the TAG-BCAW Manual	1-1-9
Table 4-2-1	National Collections for Specimens	4-2-9
Table 5-2-1	Where to Find More Information About Target Weeds	5-2-3
Table 5-2-2	Locating Biological Control Agent Information	5-2-4
Table 5-2-3	Locating Biological Control Agent Information	5-2-4
Table 5-2-4	Checklist for Field Release of Biological Control Agent of Weeds Evaluation	5-2-5
Table 5-2-5	TAG-BCAW Reviewer's Overall Recommendation Checklist—Petitions for Field Release of Biological Control Agents of Weeds	5-2-17
Table 5-3-1	References for Developing a Test Plant List	5-3-13
Table 5-4-1	Where to Find More Target Weed Information	5-4-4
Table 5-4-2	Evaluation Checklist for Test Plant Lists	5-4-5
Table 5-4-3	Checklist for Reviewer's Completion of Test Host Plant Lists	5-4-17
Table 6-2-1	Effects Analysis and Agency Determination	6-2-7
Table 6-2-2	Conservation Measures for Species Identified in Table 6-2-1	6-2-8
Table A-1-1	TAG-BCAW Membership Directory	A-1-1
Table B-1-1	PPQ Form 599, Import Label for Living Regulated Organisms (red and white label) Mailing or Shipping (new plain paper (nongummed) or special adhesive (gummed) label issued starting September 9, 2014)	B-1-11
Table D-1-1	Directory of U.S. Fish and Wildlife Service (FWS) Regional Offices	D-1-1





# Introduction

---

## Contents

Purpose	1-1-1
Scope	1-1-2
What the Manual Covers	1-1-2
What the Manual Does Not Cover	1-1-3
Authority	1-1-3
Users	1-1-3
Related Documents	1-1-3
Authority	1-1-3
Application	1-1-4
Conventions	1-1-5
Advisories	1-1-5
Using the Manual	1-1-8
Reporting Problems With or Suggestions for the Manual	1-1-9
Manual Updates	1-1-10
Ordering Manuals and Revisions	1-1-10

---

## Purpose

The *Introduction* chapter of the *Technical Advisory Group for Biological Control Agents of Weeds Manual* (TAG-BCAW Manual) provides guidance for the technical advisory group and the scientific community, including petitioners and TAG-BCAW reviewers.

The TAG-BCAW Manual serves the following functions:

- ◆ Information guide for other users
- ◆ Reference guide for preparing petitions
- ◆ Reference guide for preparing test plant lists
- ◆ Reference guide for reviewing and evaluating petitions for field release of biological control agents of weeds in the United States
- ◆ Reference guide for reviewing and evaluating test plant lists
- ◆ Training tool for orienting TAG-BCAW members

## Scope

### What the Manual Covers

The TAG-BCAW Manual is written specifically for researchers preparing and submitting petitions or test plant lists associated with the proposed release of biological control agents of weeds, and for TAG-BCAW members responsible for reviewing and evaluating submitted petitions and test plant lists.

The manual contains the following chapters:

- ◆ [Introduction](#)
- ◆ [Technical Advisory Group](#)
- ◆ [Petitions and Permitting](#)
- ◆ [Biological Control of Weeds](#)
- ◆ [Format and Evaluation](#)
- ◆ [ESA Compliance](#)

The [Technical Advisory Group](#) chapter provides new members with a history of the advisory group, its charter, and insight into the review process that the TAG-BCAW follows.

The [Petitions and Permitting](#) chapter provides a flowchart of the petition process and information about APHIS' process for petitioners to follow for obtaining permits.

The [Biological Control of Weeds](#) chapter provides basic information about topics such as identification and characterization of biological control agents of weeds, host specificity, and testing methods.

The [Format and Evaluation](#) chapter provides formats for petitions for field release and for test plant lists respectively. The checklists are for TAG-BCAW members to follow as they review petitions for field release of biological control agents of weeds and test plant lists. The chapter also provides the evaluation guidelines to facilitate the review, evaluation, and approval processes. TAG-BCAW members use these as they review test plant lists and petitions for field release of biological control agents of weeds. Throughout the evaluation guidelines, TAG-BCAW members are prompted to record their comments on a Reviewer's Comment Sheet.

The [ESA Compliance](#) chapter provides an overview of Section 7 of the Endangered Species Act (ESA) and Fish and Wildlife Service's role on TAG-BCAW. Researchers and petitioners are encouraged to read this and the ESA.

The manual contains appendices, a glossary, and an index.

### What the Manual Does Not Cover

The manual **does not** cover the following:

- ◆ Approval for permits
- ◆ Approval for petitions
- ◆ Final decisions on the release of biological control agents of weeds

---

## Users

The *Technical Advisory Group for Biological Control Agents of Weeds Manual* (TAW-BCAW Manual) is written for use by TAG-BCAW members and by petitioners. Parts of this manual may be referenced by others, such as experts within the Federal agencies represented on TAG-BCAW, researchers, external reviewers, university experts, foreign nationals who are involved in evaluating biological control agents, and members of international organizations, such as the North American Plant Protection Organization (NAPPO).

The experience level of the TAG-BCAW Manual's users will vary, but TAG-BCAW members should fully understand and communicate their Agency's or organization's current perspective on biological control activities.

---

## Related Documents

### Authority

Enabling legislation provides the authority to carry out the mission of protecting American agriculture from plant pests. Legislative Acts are the fundamental authority granted by Congress to the Secretary of Agriculture to promulgate regulations to protect American agriculture. The regulatory authority for taking the actions listed in this manual is contained in the Plant Protection Act (PPA). The PPA provides the authority to prohibit or restrict imports, exports, or interstate movement of biological control agents, plant pests, plant products, plants, noxious weeds, and means of conveyance.

The regulatory authority for taking the actions listed in the manual are contained in the following:

- ◆ Endangered Species Act (ESA) (16 U.S.C. 1531 et. seq.)
- ◆ National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et seq.)
- ◆ Plant Protection Act of 2000 (PPA) (7 U.S.C 7701 et. seq.)
- ◆ Coastal Zone Management Act (16 U.S.C. 1451 et. seq.)
- ◆ Executive Order 13112 (64 CFR 6184) for Invasive Species

### **Plant Protection Act of 2000**

The Plant Protection Act of 2000 (7 U.S.C. 7701 et seq.) provides the Secretary of Agriculture with the authority to regulate “any enemy, antagonist, or competitor used to control a plant pest or noxious weed.”

### **Cooperating Organizations**

The following are cooperating agencies, countries, and organizations for the TAG-BCAW Manual:

- ◆ Canada, Agriculture and Agri-Food Canada
- ◆ Mexico, SAGARPA-SENASIA-DGSV
- ◆ National Plant Board
- ◆ United States Department of Defense (USDOD), U.S. Army Corps of Engineers (COE)
- ◆ United States Environmental Protection Agency (EPA)
- ◆ United States Department of Agriculture (USDA), Agricultural Research Service (ARS)
- ◆ USDA, Animal and Plant Health Inspection Service (APHIS)
- ◆ USDA, Forest Service (FS)
- ◆ USDA, National Institute of Food and Agriculture (NIFA)
- ◆ USDA, Natural Resource Conservation Service
- ◆ United States Department of Interior (USDI), Bureau of Indian Affairs (BIA)
- ◆ USDI, Bureau of Land Management (BLM)
- ◆ USDI, Bureau of Reclamation (BR)
- ◆ USDI, Fish and Wildlife Service (FWS)
- ◆ USDI, National Park Service (NPS)
- ◆ USDI, U.S. Geological Survey (USGS)
- ◆ Weed Science Society of America (WSSA)

---

## **Application**

This manual contains information for TAG-BCAW members to use as they review test plant lists and petitions for release. This manual contains instructions for petitioners to follow to prepare and submit a petition; and provides instructions for petitioners to follow to submit an application for a permit.

---

## Conventions

Conventions are established by custom and are widely recognized and accepted. Major conventions used in this manual follow.

### Advisories

Advisories are used throughout the manual to bring important information to your attention. Please carefully review each advisory. The definitions coincide with those of the American National Standards Institute (ANSI), and are in the format shown below.

#### **DANGER**

DANGER indicates a hazardous situation which, if **not** avoided, will result in death or serious injury.

#### **WARNING**

WARNING indicates a hazardous situation which, if **not** avoided, could result in death or serious injury.

#### **CAUTION**

CAUTION indicates a hazardous situation which, if **not** avoided, could result in minor or moderate injury.

#### **NOTICE**

NOTICE is used to address practices **not** related to physical injury.

#### **SAFETY**

SAFETY is used to indicate specific safety-related instructions or procedures.

### Boldface

Boldface type is used to emphasize important words throughout this manual. These words include: **always, cannot, do not, does not, except, lacks, must, neither, never, no, nor, not, only, other than.**

## Bullets

Bulleted lists indicate there is **no** specific order to follow for the information listed.

## Change Bar

A black change bar (see left margin) is used to indicate a change appearing on a revised page. Unfortunately change bars **do not** always appear when text is deleted.

## Contents

Every chapter has a table of contents listing **only** the first- and second-level headings with the chapter section.

## Control Data

Control data is located at the top and bottom of each page to help manual users keep track of where they are in the manual and to be aware of updates to specific chapters and appendixes in the manual. At the top of each page is the chapter title and first-level heading for that page. At the bottom of each page is the transmittal number (month, year, number), title of the manual, and page number.

## Examples

Examples are used to clarify a point by applying to a real-world situation.

**EXAMPLE** Examples are graphically-placed boxes within the text as a means of visually separating information from other information contained on the page. Examples appear in a box like this.

## Footnotes

Footnotes comment on or cite a reference to text and are referenced by number. The footnotes used in this manual include general text footnotes, figure footnotes, and table footnotes.

General text footnotes are located at the bottom of the page after a thin green line half the width of the page and flow numerically throughout a chapter.

When space allows, figure and table footnotes are located directly below the associated figure or table. However, for multi-page tables and tables covering the entire length of a page, the footnote numbers and footnote text **cannot** be included on the same page. If a figure or table continues beyond one page, then the associated footnotes will appear on the page following the end of the figure or table. Each table's footnotes are individually numbered, and will be indicated beginning with footnote number 1.

## Heading Levels

Within each chapter and section there are up to four heading levels. The first-level heading is indicated by a horizontal line across both the left and right columns, and the heading follows directly below and across both columns. The second-level heading is in the right-hand column with the text beginning below and is subordinate to the first-level heading. The third-level heading is in the right-hand column with the text following below and is subordinate to the second-level heading. The fourth-level heading is followed by a period, is inside the right column, and is subordinate to the third-level heading.

## Hyperlinks to Figures, Headings, and Tables

Figures, headings, and tables are cross-referenced in the body of the manual and are in blue hypertext in the on-line manual.

**EXAMPLE** See [Reporting Problems With or Suggestions for the Manual](#) on page 1-9 to determine where to report problems with this manual.

## Indentations

Content information, lengthy quotations, and entry requirements which are summarized from the *Code of Federal Regulations*, import permits, or policies are indented.

## Italics

The following items are italicized throughout this manual:

- ◆ Cross-references to headings
- ◆ Publication names
- ◆ Scientific names of commodities

## Numbering Scheme

A three-level numbering scheme is used in this manual for figures, pages, and tables. The first number represents the chapter. The second number represents the section. The third number represents the page, table, or figure. Dashes are used in numbering to differentiate from decimal points.

## Transmittal Number

The transmittal number contains the month, year, and a consecutively-issued number (beginning with -01 for the first transmittal for each edition and increasing consecutively for each update to the edition). The transmittal number is **only** changed when a specific chapter, section, front matter, or back matter is updated. If **no** changes are made to a specific chapter or section, then the transmittal number for that chapter or section remains unchanged. The transmittal number **only** changes for the entire manual when a new edition is issued or changes are made to the entire manual.

**EXAMPLE** 01/2021-01 is the transmittal number for this second edition and is located in the control data in the footer area of the pages in this manual.

01 is the month the manual was issued  
2021 is the year the manual was issued  
-01 is the first transmittal for this second edition

---

## Using the Manual

Review the contents of the manual to get a feel for the scope of the material covered. Glance through the section that you will be using, and familiarize yourself with the organization of the information. Use the table of contents which is listed on the first page of each chapter or section and some appendixes to find the information you need. If the table of contents is **not** specific enough, then use the index to find the topic and corresponding page number or use the pdf search feature.

**EXAMPLE** To find information about APHIS' perspective on the biological control of weeds in North America, see [Animal and Plant Health Inspection Service \(APHIS\)](#) on [page 2-3-2](#).



## Reporting Problems With or Suggestions for the Manual

Use [Table 1-1-1](#) to determine where to report problems, disagreements, or improvements which directly affect the contents of the TAG-BCAW Manual.

**Table 1-1-1 Where to Report Problems With or Suggestions for the TAG-BCAW Manual**

If you:	Then:
Are <b>not</b> able to access the on-line manual	CONTACT PPQ's Manuals Unit by email <a href="mailto:PPQ.IRM.ISMU.Manuals.Feedback@usda.gov">PPQ.IRM.ISMU.Manuals.Feedback@usda.gov</a> or call 240-529-0350
Have a problem with the content of the manual that requires an answer	CONTACT the TAG-BCAW Executive Secretary  Mr. Gregg Goodman, TAG-BCAW Executive Secretary <b>USDA-APHIS-PPQ</b> 4700 River Road, Unit 133, 4C-01.48 Riverdale, MD 20737  Email: <a href="mailto:gregg.b.goodman@usda.gov">gregg.b.goodman@usda.gov</a>  Phone: 301-851-2074 Fax: 301-734-5269
Have a question with or suggestion for improving the content of the manual	1. PRINT the <a href="#">Comment Sheet</a> 2. Write your suggestion 3. SEND the completed comment sheet to the TAG-BCAW Executive Secretary by Email or U.S. Mail  Mr. Gregg Goodman TAG-BCAW Executive Secretary <b>USDA-APHIS-PPQ</b> 4700 River Road, Unit 133, 4C-01.48 Riverdale, MD 20737  Email: <a href="mailto:gregg.b.goodman@usda.gov">gregg.b.goodman@usda.gov</a>
Have a suggestion for improving the formatting (composition, design, layout), grammar, or spelling	CONTACT PPQ's Manuals Unit at <a href="mailto:PPQ.IRM.ISMU.Manuals.Feedback@usda.gov">PPQ.IRM.ISMU.Manuals.Feedback@usda.gov</a> or call 240-529-0350

## Manual Updates

The USDA-APHIS-PPQ Manuals Unit issues and maintains manuals electronically on the [Manuals Unit Web site](#).

Immediate update revisions to the manual are issued and distributed via email to CBP Agriculture Specialists, PPQ employees, current TAG-BCAW members, and subscribers to the [USDA-APHIS Stakeholder Registry](#) (go to the Manuals Updates/Import Inspection Manuals/ listed; and check the box for the *Technical Advisory Group for Biological Control Agents of Weeds Manual*).

Each immediate update contains the following information:

- ◆ Link to access and download the on-line manual
- ◆ List of the revised pages
- ◆ Purpose of the revision(s)
- ◆ Transmittal number

## Ordering Manuals and Revisions

Although using the on-line manuals is the preferred method, USDA-APHIS employees may order hard copies of manuals from the APHIS Printing, Distribution, Mail Center, and Copier Services Center in Riverdale, Maryland. Visit the Riverdale Print Shop Web site for detailed information and printing costs. The Manuals Unit is **not** responsible for printing costs.

# Technical Advisory Group

## *Introduction*

---

### Contents

Introduction 2-1-1

Biological Control of Weeds 2-1-1

History 2-1-2

    Subcommittee on Biological Control of Weeds 2-1-2

    Working Group 2-1-2

    Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW) 2-1-3

---

### Introduction

The *Introduction* section of the *Technical Advisory Group* chapter provides information about the Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW).

---

### Biological Control of Weeds

Biological control can be defined as the deliberate use of natural enemies (competitors, parasites, pathogens, predators, and other organisms) to suppress and maintain populations of a target pest species (insects, mites, plant pathogens, and other pest organisms) below densities that cause economic and/or environmental damage.

Classical biological control of weeds consists of returning to the native range of the target weed, identifying its complex of natural enemies, testing extensively, and releasing one or more host specific, natural enemies to control the target weed. See [Biological Control](#) on page 4-1 for basic information. Many organizations are involved in searching, testing, and introducing potential biological control agents of weeds. Some of these organizations include the USDA Agricultural Research Service (ARS); the USDA Forest Service (FS); USGS Biological Resources Division; State departments of agriculture and universities; Agriculture and Agri-Food Canada, and CAB International. Within the United States, the importation and the release of biological control agents of weeds are regulated by USDA-APHIS because the agents may potentially present a plant pest risk.

## History

Over the last 50 years, technical advisory groups have assisted researchers and regulatory agencies in evaluating proposed biological control agent introductions for biological control of weeds in the United States.

### Subcommittee on Biological Control of Weeds

The Subcommittee on Biological Control of Weeds, the first advisory group, was established in 1957. The initial membership included representatives from the U.S. Department of the Interior's (USDI) Bureau of Reclamation, Bureau of Land Management, and Fish and Wildlife Service; and from the U.S. Department of Agriculture's (USDA) Forest Service and Agricultural Research Service.

The initial responsibilities of the Subcommittee were as follows:

- ◆ Advise whether certain plant species targeted for biological control are universally regarded as weeds and recommend a course of action for situations involving conflicts of interest; and
- ◆ Recommend non-target plant species to be tested against the phytophagous organisms proposed for introduction.

Through the 1960s the Subcommittee communicated primarily through correspondence, **only** meeting periodically to discuss biological control of weeds. An informal, reciprocal review of proposals began in 1962 between the United States and Canada. In 1969 the membership of the Subcommittee was expanded to include subject matter experts in plant taxonomy, ornamentals, and plant quarantine. At that time, the Bureau of Reclamation dropped its membership.

### Working Group

In 1971 the Subcommittee on Biological Control of Weeds became known as the Working Group on Biological Control of Weeds. At this time, the Working Group began contacting Mexican officials concerning U.S. proposals. Canadian and Mexican comments were invited because the Working Group knew that an introduced organism recognizes **no** political boundaries and its introduction needed to be considered on a continental basis. Membership changed over the years because of reorganizations and the need to add members from the Environmental Protection Agency, Cooperative State Research, Education, and Extension Service (now the National Institute of Food and Agriculture), and the U.S. Army Corps of Engineers.

Although the Subcommittee and Working Group were formed to provide advice primarily to the researchers, the Subcommittee's and Working Group's comments could be used by APHIS-PPQ in making decisions about issuing

permits for importation or release. Responsibilities and procedures followed by the Working Group also changed over the years.

Important additional responsibilities taken on by the Working Group were as follows:

- ◆ Review proposals to introduce candidate organisms into quarantine facilities; and
- ◆ Review adequacy of documentation supporting a proposed field release.

### **Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW)**

In January 1987, the Working Group was replaced by the Technical Advisory Group (TAG), now known as the Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW). Then and now, TAG-BCAW functions under USDA-APHIS Plant Protection and Quarantine (APHIS-PPQ). Its membership continues to be voluntary and now **must** be in accordance with the Federal Advisory Committee Act (FACA). Membership is indefinite until members retire or their Agencies or organizations name someone else. TAG-BCAW is facilitated by an Executive Secretary from APHIS-PPQ. The TAG-BCAW Executive Secretary is **not** a voting member. The TAG-BCAW Chair is elected by its members for a 3-year, renewable term.

Over the years, the TAG-BCAW has adapted to the needs of both researchers and regulatory agencies to better serve when they propose introducing an exotic organism into the United States for the biological control of weeds.

Today the TAG-BCAW, with their scientific expertise, functions as a liaison to the biological control community and APHIS. The TAG-BCAW is able to advise potential petitioners about issues related to test plant lists and host specificity testing and research.

APHIS-PPQ seeks the advice of and recommendations from the TAG-BCAW, and relies on the TAG-BCAW to provide scientifically-justified, unbiased recommendations. APHIS considers TAG-BCAW's recommendations before performing a National Environmental Policy Act (NEPA) analysis; and then considers TAG-BCAW's recommendations on proposed biological control agent of weeds before making a permit decision.

The Plant Protection Act gives APHIS the authority to regulate the importation and release of biological control agents that may potentially present a plant pest risk. These regulations can be found in 7 CFR 330.200.

The expectation is that researchers will involve the TAG-BCAW relatively early in a program to suggest the inclusion of certain test plants, perform, a

NEPA analysis, identify conflicts of interest, and assess risk associated with a release.

TAG-BCAW **does not** inform researchers of areas where a plant species may be considered a weed or a desirable plant. TAG-BCAW members **do not** make final decisions on the approval and permitted action for the release of biological control agents of weeds in North America.

TAG-BCAW members **only** recommend to APHIS-PPQ that a proposed biological control agent be approved or denied permission for release, and recommend to petitioners specific action before they apply for a formal permit.

#### NOTICE

TAG-BCAW **does not** approve petitions or permits. See [APHIS Permitting Process](#) on page 3-1.

In summary, the TAG-BCAW continues to provide APHIS-PPQ with a process in which petitions and test plant lists are reviewed by uninvolved parties from varying perspectives and concerns and varying scientific disciplines. TAG-BCAW continues to serve as a science-based link between the research community and regulatory agencies, and to provide input from stakeholders.

#### References

- Coulson, Jack R. 1992. The TAG: development, functions, procedures, and problems. In: Regulations and guidelines: critical issues in biological control, Proceedings of a USDA/CSRES national workshop; 53–60.
- Drea, John J., Jr. 1991. The philosophy, procedures, and cost of developing a classical biological control of weeds project. *Natural Areas Journal* 11(3); 143–147.
- Klingman, Dayton L.; Coulson, Jack R. 1983. Guidelines for introducing foreign organisms into the United States for the biological control of weeds. *Bulletin of the Entomological Society of America* 29(3); 55–61.

# Technical Advisory Group

## Charter

---

### Contents

Introduction	2-2-1
Charter, Technical Advisory Group for Biological Control Agents of Weeds, October 1997, Revised 2010	2-2-1
Mission	2-2-1
Objectives	2-2-2
Expectations	2-2-2
Standard Operating Procedures	2-2-2
Duties of TAG-BCAW Members	2-2-2
Duties of the TAG-BCAW Chair	2-2-3
Duties of the TAG-BCAW Executive Secretary	2-2-3
Duties of USDA-APHIS-PPQ	2-2-4
Annual Meeting	2-2-4
Administration	2-2-4
Federal Advisory Committee Act (FACA)	2-2-5
Membership	2-2-5

---

### Introduction

The *Charter* section of the *Technical Advisory Group* chapter describes the TAG-BCAW's charter, mission, objectives, and standard operating procedures.

---

## Charter, Technical Advisory Group for Biological Control Agents of Weeds, October 1997, Revised 2010

### Mission

To facilitate biological control of weeds in North America by providing guidance to researchers and recommendations to regulating agencies for or against the release of nonindigenous biological control agents of weeds. This is based on considerations of potential nontarget impacts, conflicts of interest, natural resources, agricultural production, and the Endangered Species Act (ESA) Threatened and Endangered Species List.

## Objectives

Incorporate member agencies' concerns and perspectives into planning biological control programs.

Provide an exchange of views, information and advice for individuals who plan to ask various Federal and State regulatory agencies for permission to release these agents into the environment.

Provide recommendations to APHIS-PPQ for use in making permitting decisions.

## Expectations

Individuals planning to release a nonindigenous biological control agent should contact the TAG-BCAW early in the research program, particularly for species targeted for the first-time release of a biological control agent in the North America.

TAG-BCAW members review two types of documents: the proposed plant list for host specificity testing (test plant list) and the petition for first-time field release of a nonindigenous organism. TAG-BCAW members may suggest inclusion of certain test plants, identify conflicts of interest, and assess potential risks associated with an environmental release. The person seeking permission to release a biological control agent into the environment addresses these different perspectives. The exchange of scientific information helps Federal regulatory officials evaluate potential effects of the biological control agent of weeds on target and nontarget plants in North America.

---

## Standard Operating Procedures

### Duties of TAG-BCAW Members

Duties of TAG-BCAW members are as follows:

- ◆ Represent their Agency's or organization's interests by reviewing petitions from the organization's current perspective on biological control;
- ◆ Review each petition to evaluate risk to agriculture, human health, and the environment;
- ◆ Identify and consult subject matter experts who are familiar with the taxonomy, biology, ecology, and other aspects of the organisms being considered for release and the target weed;
- ◆ Provide a written response consolidating their Agency's or organization's comments to the TAG-BCAW Executive Secretary within the deadline;
- ◆ Participate in the annual TAG-BCAW meeting; and



- ◆ Appoint an alternate within their organization to serve in the absence of the official member.

### **Duties of the TAG-BCAW Chair**

The TAG-BCAW Chair is a TAG-BCAW member, elected by the TAG-BCAW membership to serve a 3-year term. The Chair may serve an unlimited number of terms.

Duties of the TAG-BCAW Chair are as follows:

- ◆ Arrange and preside over meetings of TAG-BCAW;
- ◆ Assess all TAG-BCAW members' continued involvement on the TAG-BCAW to assist in keeping the respective organizations actively included on the TAG-BCAW;
- ◆ Contact TAG-BCAW Agencies and organizations to request a new qualified candidate who can represent that organization and replace non-active TAG-BCAW members;
- ◆ Help build consensus among reviewers with divergent viewpoints. The Chair may call meetings or telephone conferences including outside specialists and the involved researcher;
- ◆ Maintain records of TAG-BCAW recommendations; and
- ◆ Review all recommendations of TAG-BCAW members and provide consolidated recommendations to the petitioner, TAG-BCAW members, appropriate officials in Canada and Mexico, APHIS TAG-BCAW Executive Secretary, and other interested parties.

### **Duties of the TAG-BCAW Executive Secretary**

The TAG-BCAW Executive Secretary is an APHIS employee.

Duties of the TAG-BCAW Executive Secretary are as follows:

- ◆ Assign due dates for reviews of all petitions and test plant lists;
- ◆ Compile petition and test plant list reviews and forward to the TAG-BCAW Chair;
- ◆ Develop with the TAG-BCAW Chair, the TAG-BCAW annual meeting agenda, date, time, and location;
- ◆ Facilitate the distribution of petitions and test plant lists to TAG-BCAW members;
- ◆ Make all arrangements for the TAG-BCAW annual meeting (daily meeting space, hotel, shuttle, etc.);

- ◆ Maintain a filing system and perform other archival functions for TAG-BCAW;
- ◆ Maintain the [TAG-BCAW Web site](#) and include APHIS permit decisions on the Internet;
- ◆ Receive and acknowledge receipt of all submitted petitions and test plant lists;
- ◆ Receive and respond to requests to extend review deadlines;
- ◆ Serve as the contact for *Technical Advisory Group for Biological Control Agents of Weeds Manual* (TAG-BCAW Manual) maintenance; and
- ◆ Transmit recommendations from the TAG-BCAW Chair to APHIS-PPQ.

### **Duties of USDA-APHIS-PPQ**

Duties of USDA-APHIS-PPQ for petitions are as follows:

- ◆ Assure compliance with applicable statutes and regulations;
- ◆ Conduct training workshops as needed;
- ◆ Consider TAG-BCAW's recommendations;
- ◆ Evaluate permit requests for movement of biological control agents of weeds by conducting a plant pest risk assessment;
- ◆ If a permit application is submitted, then APHIS may initiate the development of environmental and biological assessments when needed;
- ◆ May invite the researcher to submit a permit application;
- ◆ Perform the APHIS-PPQ permit process for movement of biological control agents of weeds and develop and communicate permitting policy pertaining to movement of these organisms; and
- ◆ When the TAG-BCAW recommends to APHIS to release an agent, then APHIS will review the recommendations and if reservations are noted ensure that these are addressed.

### **Annual Meeting**

The TAG-BCAW Chair calls an annual meeting to evaluate the effectiveness of the TAG-BCAW, and to discuss controversial issues relating to biological control of weeds in North America. The TAG-BCAW membership elects a Chair every 3 years, during the annual meeting.

### **Administration**

USDA-APHIS-PPQ will be responsible for the administrative maintenance of Federal Agencies' representation.

## Federal Advisory Committee Act (FACA)

TAG-BCAW meetings shall be conducted in compliance with the Federal Advisory Committee Act (FACA).

The law as amended (P.L. 104-4, Sec. 204), states the following:

Meetings between State, Local, Tribal and Federal Officers - The Federal Advisory Committee Act (5 U.S.C. App.) shall **not** apply to actions in support of intergovernmental communications where:

- (1) Meetings are held exclusively between Federal officials and elected officers of State, local, and tribal governments (or their designated employees with authority to act on their behalf) acting in their official capacities; and
- (2) Such meetings are solely for the purposes of exchanging views, information, or advice relating to the management of implementation of Federal programs established pursuant to public law that explicitly or inherently share intergovernmental responsibilities or administration.

FACA **does not** apply to meetings of TAG-BCAW because TAG-BCAW members include some Federal officials, some designated State officials, and some organizations. The TAG-BCAW members may contact non-Federal, State, local, or tribal parties to obtain information. Therefore, Canada, Mexico, researchers, industry, and professional or other societies may be contacted on an ad hoc basis.

The TAG-BCAW focuses primarily on providing assistance to the individuals who will seek permits. Secondly, TAG-BCAW provides a communication conduit within a scientific framework for APHIS.

## Membership

APHIS will solicit one representative from each of the following Agencies:

- ◆ DOD, U.S. Army Corps of Engineers
- ◆ U.S. Environmental Protection Agency
- ◆ USDA, Animal and Plant Health Inspection Service
- ◆ USDA, Agricultural Research Service
- ◆ USDA, Forest Service
- ◆ USDA, National Institute of Food and Agriculture
- ◆ USDA, Natural Resource Conservation Service
- ◆ USDI, Bureau of Indian Affairs
- ◆ USDI, Bureau of Land Management

- ◆ USDI, Bureau of Reclamation
- ◆ USDI, National Park Service
- ◆ USDI, U.S. Fish and Wildlife Service
- ◆ USDI, U.S. Geological Survey

APHIS may solicit members who are State or Federal government employees (one each) from the following organizations:

- ◆ National Plant Board
- ◆ Weed Science Society of America
- ◆ Other Federal Agencies expressing interest in participation

Each TAG-BCAW member is a representative of his/her respective Agency or organization. A TAG-BCAW member's **lack** of participation or response to the TAG-BCAW petitions is of concern for all involved. Everyone's best interests are served when all members are active.

The TAG-BCAW Chair will assess each TAG-BCAW member's continued involvement on the TAG-BCAW in trying to keep the respective Agencies or organizations as part of TAG-BCAW. If a current TAG-BCAW member is non-active, then the TAG-BCAW Chair has the prerogative to contact the represented Agency or organization and request a new qualified candidate to represent the Agency or organization and replace the non-active current TAG-BCAW member.

Furthermore, if an organization's representative **does not** provide comments or the representative **does not** request an extension of a petition's documented deadline, then the TAG-BCAW Chair interprets this to mean the organization **does not** oppose the petition.

# Technical Advisory Group

## *Agencies and Organizations' Perspectives*

---

### Contents

Introduction	<b>2-3-1</b>
U.S. Department of Agriculture (USDA)	<b>2-3-2</b>
Animal and Plant Health Inspection Service (APHIS)	<b>2-3-2</b>
Agricultural Research Service (ARS)	<b>2-3-3</b>
Forest Service (FS)	<b>2-3-3</b>
National Institute of Food and Agriculture (NIFA)	<b>2-3-4</b>
U.S. Department of the Interior (USDI)	<b>2-3-5</b>
Bureau of Indian Affairs (BIA)	<b>2-3-5</b>
Bureau of Land Management (BLM)	<b>2-3-5</b>
Bureau of Reclamation (BR)	<b>2-3-6</b>
Fish and Wildlife Service (FWS)	<b>2-3-7</b>
National Park Service (NPS)	<b>2-3-7</b>
U.S. Geological Survey (USGS)	<b>2-3-8</b>
Department of Defense (DOD)	<b>2-3-9</b>
U.S. Army Corps of Engineers (COE)	<b>2-3-9</b>
Environmental Protection Agency (EPA)	<b>2-3-9</b>
U.S. Department of Agriculture (USDA)	<b>2-3-2</b>
National Plant Board	<b>2-3-9</b>
Canada: Agriculture and Agri-Food Canada (AAFC)	<b>2-3-10</b>
Mexico: SAGARPA-SENASIA-DGSV	<b>2-3-10</b>

---

### Introduction

The *Agencies and Organizations'* section of the *Technical Advisory Group* chapter provides a brief summary of the perspective of each Agency and organization which has a representative on the TAG-BCAW. Members are responsible for reviewing and evaluating submitted petitions for release and test plant lists, and for recommending action based on their Agency's or organization's current perspective on biological control of weeds in North America.

## **U.S. Department of Agriculture (USDA)**

### **Animal and Plant Health Inspection Service (APHIS)**

The biological control activities within APHIS are performed under the regulatory authority of the Plant Protection Act of 2000, which states that, “biological control is often a desirable, low-risk means of ridding crops and other plants of plant pests and noxious weeds, and its use should be facilitated by the Department of Agriculture, other Federal Agencies, and States whenever feasible.” The Act also defines a biological control organism as any enemy, antagonist, or competitor used to control a plant pest or noxious weed. The authority to regulate biological control agents is dependent on the agents’ plant pest risks.

The Animal Plant Health Inspection Service (APHIS) is involved in biological control activities that aim to safeguard American agriculture and ecosystems and minimize the economic and environmental impacts of nonindigenous pests, weeds, and plant diseases deemed of regulatory significance to APHIS, State departments of agriculture, tribal governments, and cooperators within the United States and American territories.

APHIS biological control activities include the direct involvement of Plant Protection and Quarantine (PPQ) Field Operations (FO) personnel in distributing, releasing, and monitoring approved biological control agents for selected target pests. PPQ, through its FO and Policy Management (PM) units, also provides funds to Federal, State, university, local, and tribal project partners through cooperative trade agreements. Cooperators conduct target pest and biocontrol agent surveys, agent collections and releases, and pre- and post-release monitoring. The PPQ Center for Plant Health Science and Technology (CPHST) unit is also involved in biological control. CPHST scientists develop release and monitoring protocols, rear selected biological control agents, and incorporate biological control into integrated pest management strategies. CPHST provides funding for pre-release research and development efforts with potential biological control agents considered for U.S. release. Finally, the PPQ Pest Permitting Branch is responsible for approving or rejecting initial U.S. introduction and field release of biological control agents and for permitting subsequent interstate distribution and releases. All Agency units engage with other USDA Agencies, organizations, and a wide range of cooperators and customers to develop appropriate Agency legislation and regulations that meet U.S. needs for economical, efficient, and effective biological control programs of weeds.

### **Agricultural Research Service (ARS)**

The Agricultural Research Service (ARS) conducts research using classical and augmentative approaches to discover and develop arthropods and microbes as biological control components for integrated weed management systems in rangelands, croplands, noncroplands, and aquatic sites. ARS searches for and characterizes candidate host-specific biological control agents from foreign sites of origin of invading exotic target weeds. The Agency also discovers and develops endemic and foreign pathogens for inundative or inoculative releases against target weeds. ARS policy is to work with regulatory Agencies such as APHIS, Fish and Wildlife Service, and the Environmental Protection Agency to ensure that all of the Agency's releases/applications are in accordance with existing laws and regulations.

### **Forest Service (FS)**

The Forest Service (FS) is charged with the management of approximately 190 million acres of national forests and grasslands. The FS recognizes that the invasion of exotic plants is a key threat to continued existence of vulnerable native species, and to the integrity and healthy functioning of unique habitats. Exotic weeds also are a major problem and interfere with the FS' effective management, compromise productivity, and impede the public's enjoyment of these lands.

To control these invaders, vegetation management personnel have available to them a wide range of tools from which they **must** select those that best fit the area, the targeted weed, and local management goals. However, FS recognizes that once a weed has become widely distributed, most conventional management tools provide **only** localized relief or containment. Biological control is usually the **only** realistic approach for many weed infestations. FS is supportive of vegetation management personnel to evaluate the feasibility of using weed biological control. When suitable approved biological control agents are available, managers are encouraged to add them as a control strategy in integrated weed management programs.

When external researchers are testing new biological control agents for weeds that also affect FS lands, the FS actively encourages and supports their research through funding, providing experimental release plots, and participating in joint development programs. When weeds of concern to FS are **not** being targeted by other research agencies, FS researchers may initiate the search for, testing of, and importation of biological control agents.

### **National Institute of Food and Agriculture (NIFA)**

The Land Grant University System and the National Institute of Food and Agriculture (NIFA) have fundamental responsibility for discovering, developing, implementing, and extending technology in support of American agriculture and in concert with America's natural resources. With a Congressional mandate in each State to support agriculture in cooperation with USDA and other Agencies, scientists within the Land Grant University System are greatly involved in the development of pest management strategies and programs for implementation in agricultural, forest, pasture, rangeland, and aquatic and urban environments, including natural and modified systems. This diverse mission also includes the conduct of biological and ecological research in these environments, which often serves as the baseline for development of applied problem-solving research and education efforts.

Among the assets in research expertise which reside within the NIFA-supported Agricultural Experiment Station System, are disciplines that directly support biological control of weeds. Botany, plant ecology, land conservation and taxonomic studies in plants, animals, and microbes are among the many components of that expertise.

An additional component of NIFA is the development and delivery of information in support of biological control and other integrated pest management (IPM) strategies. This educational and implementation system provides support to the public and private sectors who are affected by biological control of weeds, as well as the weed problems themselves.



## U.S. Department of the Interior (USDI)

### Bureau of Indian Affairs (BIA)

The Bureau of Indian Affairs (BIA) has responsibility for approximately 56 million acres of Indian trust land (land held in trust by the United States for various Indian tribes and individuals). These trust lands are located within 326 reservations (i.e., pueblos, rancheros, missions, villages, communities, etc.). At present, there are 565 Federally recognized American Indian and Alaska Native tribes and villages.

Indian lands exist in all major ecosystems, from the Florida Everglades to the Alaskan Tundra, from hardwood forests to the Pacific rainforest, from the Sonoran Desert scrub to the Great Plains grassland, and include irrigated and dry cropland. These lands have been affected by the entire range of invasive species known in North America.

The BIA and/or tribal governments operate a noxious weed control program on a number of these Reservations. Currently, herbicides are the tool of greatest use. However, the use of herbicides is judicious due to Native American concerns regarding their environment. More recently integrated noxious weed control has been emphasized, including the use of biological control agents. Although success using biological control agents has been noted, insurance of host specificity remains a concern of tribal governments and their constituents. Biological control is a welcomed addition to other noxious weed control tools. Nonetheless plants of economic, cultural, and medicinal value **must** be protected from off-target damage by biological control agents.

### Bureau of Land Management (BLM)

The Bureau of Land Management (BLM) is responsible for carrying out a variety of programs for the management and conservation of resources on 253 million surface acres, as well as 700 million acres of subsurface mineral estate. Most of the public lands are located in the Western United States, including Alaska. Public lands make up about 13 percent of the total land surface of the United States and more than 40 percent of all land managed by the Federal Government. The public lands are characterized predominantly by extensive grassland, forest, high mountain, arctic tundra, and desert landscapes. The BLM manages multiple resources and uses, including energy and minerals; timber; forage; recreation; wild horse and burro herds; fish and wildlife habitat; wilderness areas; and archaeological, paleontological, and historical sites. These multiple uses create surface disturbances exposing the public lands to invasive and noxious weeds. As such, the BLM uses biological control of weeds as a component of its integrated weed management program. The policy and use of biological controls are in *BLM Manual 9014* where BLM's policy is stated as follows:

- ◆ Encourage the use of parasites, predators, and pathogens in integrated pest management programs to reduce pest organism populations to meet management objectives. This may include the use of domestic livestock to manage vegetation;
- ◆ Participate in cooperative integrated pest management programs in area-wide efforts;
- ◆ Support efforts to develop new biological control agents to the level possible as one of the tools in a balanced integrated pest management program; and
- ◆ Collect and quantify all inventory and monitoring data for all pest management efforts and evaluate the success or failure of them.

A Memorandum of Understanding exists between the BLM and APHIS which describes the interaction between these two agencies and National Environmental Policy Act compliance conditions. Prior to the release of an approved biological control agent, each State's State Office **must** examine the practitioner's *Biological Control Agent Release Proposal (BCARP)*, which is notification of a planned release. Once an agent has been released, a *Biological Control Release Record* **must** be filled out within 24 hours after release and kept on record for a minimum of 7 years. All BLM Field Offices submit a comprehensive Integrated Pest Management report to their State Office each year. Final reports are then compiled and reviewed at the National Office. These precautions ensure that **only** approved biological control agents are released and those releases are continually monitored to evaluate efficacy over time

### **Bureau of Reclamation (BR)**

The policy of the Bureau of Reclamation (BR) is to implement integrated pest management (IPM) for the control and management of pests and invasive species. As defined by the Federal Insecticide, Fungicide, and Rodenticide Act, and amended by the Food Quality Protection Act of 1996, "Integrated Pest Management is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks," and "Federal agencies shall use Integrated Pest Management techniques in carrying out pest management activities and shall promote Integrated Pest Management through procurement and regulatory policies, and other activities."

Reclamation views biological control as an important tool in the IPM toolbox. **Only** by using the combined suite of IPM tools, including biological control, can pests and invasive plant species be successfully controlled. In addition, the TAG-BCAW is a vital component in a reviewable and transparent process during the evaluation of proposed biological control agents of weeds.

### **Fish and Wildlife Service (FWS)**

The Fish and Wildlife Service (FWS) strongly supports the development and legal and responsible use of appropriate, safe, and effective biological control agents on nuisance nonindigenous or invasive species. As the basis for approval, biological control organisms and strategies for their use **must** have undergone careful, comprehensive, and transparent testing and evaluation throughout their potential range to ensure their host specificity and determine their effects on all nontarget organisms, especially Federally-listed species or those considered for designation under the Endangered Species Act (ESA). Biocontrol organisms imported into, transported within, and released into the United States should be free of pathogens or parasites, so as **not** to unintentionally introduce other nonindigenous species. Additionally, the media used to ship biocontrol organisms **must not** include other nonindigenous organisms. Approval **must** involve open public review, as well as scientific peer review of test results, environmental risk assessment, and other applicable analyses. If biocontrol organisms are the most effective and appropriate means available, then they should be used on National Wildlife Refuges and other lands and waters under the jurisdiction of the Service.

### **National Park Service (NPS)**

The National Park Service (NPS) relies on an integrated pest management (IPM) approach to manage pest species. The NPS considers biological control an important tool in an IPM strategy. In addition, the NPS management policies recognize the use of biological control agents on NPS lands as one of the limited reasons for releasing non-native organisms on NPS lands. However, the use of biological control agents should be targeted towards non-native species. In that regard, biological control agents **must** be thoroughly and scientifically tested as to their host specificity, safety, and potential effects upon nontarget organisms before release. Biological control agents should be free of parasites and pathogens to reduce the risk of introducing additional non-native species into the United States and creating additional pest management problems. The results of pre-release testing of biological control agents **must** receive critical scientific peer review as well as public review and comment before agents are released.

Biological control is a welcome addition to other noxious weed control tools. Nonetheless, plants of economic, cultural, and medicinal value **must** be protected from off-target damage by biological control agents.

### **U.S. Geological Survey (USGS)**

The United States Geological Survey (USGS) conducts investigations of non-native invasive plants, animals, and disease organisms, including their biology and ecology, vectors and factors in their spread, and their effects on terrestrial and aquatic ecosystems and native biota. The USGS has capabilities in the development and evaluation of methodologies and technologies for early detection of non-native invasive species (NIS), monitoring of invasions, assessment of alternative control methods, and management of NIS, including restoration of impacted habitats. Particular emphasis is on improving the capabilities of Federal land managers to address threats from NIS.

Through its research centers and cooperating universities, USGS conducts research on potential biocontrol agents for selected nonnative plants that are highly invasive in natural ecosystems (e.g., *Miconia* and strawberry guava in Hawaii). This research frequently includes international collaboration in locating, testing, and assessing potential biological control agents.

In reviewing petitions for release of biocontrol agents, USGS focuses on the appropriateness of the research methodology, post-release monitoring, and the potential biological and ecological effects of proposed control agents. In reviewing test plant lists, the emphasis is on helping to ensure adequate screening of nontarget native species.

## Department of Defense (DOD)

### U.S. Army Corps of Engineers (COE)

One of the main missions of the Army Corps of Engineers (COE) is to maintain navigable waterways in the United States. This requires **not only** overseeing the actual channels, but also water bodies influencing navigable waterways. Exotic vegetation often impedes the operation of the waterways and requires extensive management operations. Biological control technology is a key component utilized in our integrated management approach for these waterways. In addition, the Department of Defense (DOD) and Army Corps of Engineers (COE) are stewards of a wide range of habitats found on their installations and facilities. Maintaining these natural plant communities is a high priority since many are unique habitats. Petitions are reviewed to ensure that the missions of DOD organizations are **not** negatively impacted by introductions of plant biological control agents.

---

## Environmental Protection Agency (EPA)

The Environment Protection Agency (EPA) perceives the biological control of weeds as valuable in reducing risks from pesticides. EPA also views the biological control of weeds as a vital part of integrated pest management.

---

## National Plant Board

The National Plant Board is made up of the principal plant pest regulatory officials of each of the 50 States. State officials review proposed introductions of live insects, including biological control agents. USDA's permit ([PPQ Form 526, Application to Move Live Plant Pests or Noxious Weeds](#)) requires approval from both the receiving State and USDA. The National Plant Board's representation on TAG-BCAW facilitates this approval process and keeps all stakeholders involved from the beginning.

---

## Weed Science Society of America

Members of the Weed Science Society of America (WSSA) are committed to the reduction of herbicide use through adoption of integrated weed management. WSSA views all forms of biological control as important tools for prevention of economic loss due to weeds. Although profitable agriculture is the major focus, reduction of negative impacts on the environment due to agriculture is an important consideration in the selection of weed management tools.

---

## Canada: Agriculture and Agri-Food Canada (AAFC)

Agriculture's trend toward alternative solutions to chemical pesticides has led to an increasing use of biocontrol agents. Agriculture and Agri-Food Canada has a long-term commitment to sustainable agriculture via the safe importation and release of biocontrol agents of weeds. This commitment has produced several success stories which in turn have lessened Canada's dependency on chemical pesticides and taken us in the direction of a cleaner environment. Part and parcel with Canada's success and safety record is its continuing association with TAG-BCAW.

---

## Mexico: SAGARPA-SENASIA-DGSV

Mexican participation in TAG-BCAW has been very useful because biological control of weeds is in development in Mexico. Some weeds are common to Mexico, Canada, and the United States; and cooperative projects could be carried out. A greater number of agents to be imported into Mexico is expected.

Plants that are considered weeds in one country may **not** be considered weeds in another country. Given this, possible conflict of interests and impact on nontarget plants are the main concerns of Mexico. Target weed information **must** be reviewed to focus especially on the beneficial uses in Mexico and the impact on Mexican endangered and threatened species.

# Technical Advisory Group

## *TAG-BCAW Chair's Perspective*

---

### Contents

Introduction 2-4-1

TAG-BCAW Chair's Concept 2-4-1

---

### Introduction

The *TAG-BCAW Chair's Perspective* section of the *Technical Advisory Group* chapter provides the steps the current TAG-BCAW Chair follows when reviewing a petition for release of a proposed biological control agent of weeds and for examining each reviewer's comments and recommendations; and the Chair's overall concept for the TAG-BCAW and for making the final TAG-BCAW recommendation for a petition.

---

### TAG-BCAW Chair's Concept

The TAG-BCAW Chair uses his general understanding of and ideas about how TAG-BCAW helps facilitate the use of proposed biological control agents of weeds in the environment, and specifically about his role as Chair of TAG-BCAW.

The petitions that receive mixed recommendations (some recommended release; some recommended release with reservations; some **do not** recommend release) are the hardest to evaluate. Often this situation is compounded when **only** a few members have reviewed the petition and submitted a recommendation.

In general, TAG-BCAW should take a conservative stance in its recommendations. Determining if the proposed biological control agent of weeds may present a plant pest risk is the key issue. Once a biological control agent of weeds is released, it is difficult to control or manage the organism if the need should arise.

The overall concept to make the final TAG-BCAW recommendation is, "How confident are we in the testing conducted and the information presented to recommend a proposed biological control agent of weeds for release into the environment?"

## TAG-BCAW Chair's Evaluation Procedures

Before reviewing each petition as the TAG-BCAW Chair, first review each petition from the perspective of a member representing his or her Agency (for the current TAG-BCAW Chair, the U.S. Army Corps of Engineers).

Then as the TAG-BCAW Chair, evaluate each petition as follows:

1. Look over all the responses other members of TAG-BCAW have submitted.
2. Determine how many responses were submitted.
3. Determine each member's action:
  - A. Recommend **without** reservations.
  - B. Recommended with reservations.
  - C. **Not** recommended.
4. Examine each Reviewer's Comment Sheet; and make notes on the key points each reviewer has made—both negative and positive. Look for similarities in the comments among reviewers.
5. Review the notes of negative and positive points made by all the reviewers; examine each point in detail; and verify the comments made (i.e., “four larvae developed into adults when feeding on a particular plant,” or “**No** endangered plant species from the Northwest were tested”).
6. Eliminate comments that are invalid or inconsistent with the data presented. May discuss these points with the reviewer to ensure a full understanding of his/her comments.
  - A. The majority of points and concerns raised by reviewers are related to host specificity tests and the impact on nontarget plants. Address these comments first, along with the environmental impacts.
  - B. When correct and valid points are made about a particular test, examine the petition to determine if additional information has been presented that would explain the comment (i.e., “feeding on a nontarget plant **only** occurred when the larvae were artificially placed inside the stem of the plant”).
  - C. Taxonomic issues are **always** of concern. The TAG-BCAW members need to know what biological control agent is being tested and what weed is being targeted. When there is a concern about the taxonomic information, you may seek additional reviews from a recognized authority. Often taxonomic issues are raised by a taxonomic authority on the particular group. Sometimes taxonomic issues develop when the researcher is substituting one plant for a threatened or endangered one,



which often requires getting additional information to validate or refute concerns.

- D. Comments on petitions for release that address points outside of TAG-BCAW's charge hold little weight (i.e., "since research funding for biological control is scarce, I feel that the researcher should devote his efforts to studying another target plant"). TAG-BCAW is concerned with the use of the proposed biological control agent of weeds and is **not** concerned with setting research priorities.
7. If a reviewer's comments are partially correct and may **not** be completely valid, then attempt to have the reviewer and the researcher discuss the concern.
  8. If some of the points **cannot** be resolved after deliberations and discussions between the researcher and the reviewer, then begin weighing the factors that are in contention. Often, reviewing the entire petition is useful when there are mixed views from the researchers.
    - ❖ Is there a concern with plant pest risk to nontarget plants?
    - ❖ Does the host specificity test cover a reasonable representation of the species identified on the test plant list?
    - ❖ Is there a problem with taxonomy?
    - ❖ Has this proposed biological control agent of weeds been reviewed previously? If so, what were the points that caused the proposed biological control agent of weeds **not** to be recommended?
    - ❖ Has the researcher addressed previous TAG-BCAW questions?
    - ❖ Does the researcher appear to be concerned and conscientious in the studies?
  9. After re-examining all the significant questions that are unresolved, recommend an action from TAG-BCAW that you believe you can justify.
  10. Write a letter to APHIS-PPQ and include the following:
    - A. If the recommendation is to release, then include key points about the reason for the recommendation. Identify the minor points or problems that the researcher should address with the reviewer or APHIS before a release is made.
    - B. If the recommendation is **not** to release, then include key reasons for the recommendation, such as the following:
      - ⇒ Recommend tests that may answer and resolve the questions raised;
      - ⇒ Attempt to develop a list of major concerns or questions that caused this recommendation; and

- ⇒ Indicate that the researcher and the reviewers should directly discuss the points further.
11. Provide copies of the letter (sent to APHIS-PPQ) to the researcher, TAG-BCAW members, and other interested parties.
  12. TAG-BCAW's response to APHIS is just a recommendation and is **not** a final decision. The recommendation of TAG-BCAW is **not** a majority rule verdict; that is, if eight reviewers recommend release and four reviewers recommend **not** to release, then TAG-BCAW's recommendation is **not** necessarily to release. In addition, unresolved comments from a single reviewer recommending that a proposed biological control agent of weeds **not** be released **does not** mean that TAG-BCAW will recommend against release.

# Petitions and Permitting

## *TAG-BCAW Flow Chart for Petitions for Field Release and Test Plant Lists*

---

### Contents

Introduction [3-1-1](#)

[TAG-BCAW Petitions for Field Release and Test Plant Lists Flow Chart](#)  
[3-1-2](#)

---

### Introduction

The *TAG-BCAW Flow Chart for Petitions for Field Release and Test Plant Lists* section of the *Petitions and Permitting* chapter provides a flow chart for the documentation flow of petitions and test plant lists.

#### NOTICE

The Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW) Chair consolidates recommendations that are received from TAG-BCAW members. The *TAG-BCAW Manual* provides an understanding of how the TAG-BCAW Chair reaches a final TAG-BCAW recommendation.

The Technical Advisory Group for Biological Control Agents of Weeds' (TAG-BCAW) entire review process is driven by the APHIS permitting process (see [Permitting Process for Weed Biological Agents](#) on page [3-2-2](#) for more information).

# TAG-BCAW Petitions for Field Release and Test Plant Lists Flow Chart

Continue to the flow chart in [Figure 3-1-1](#).

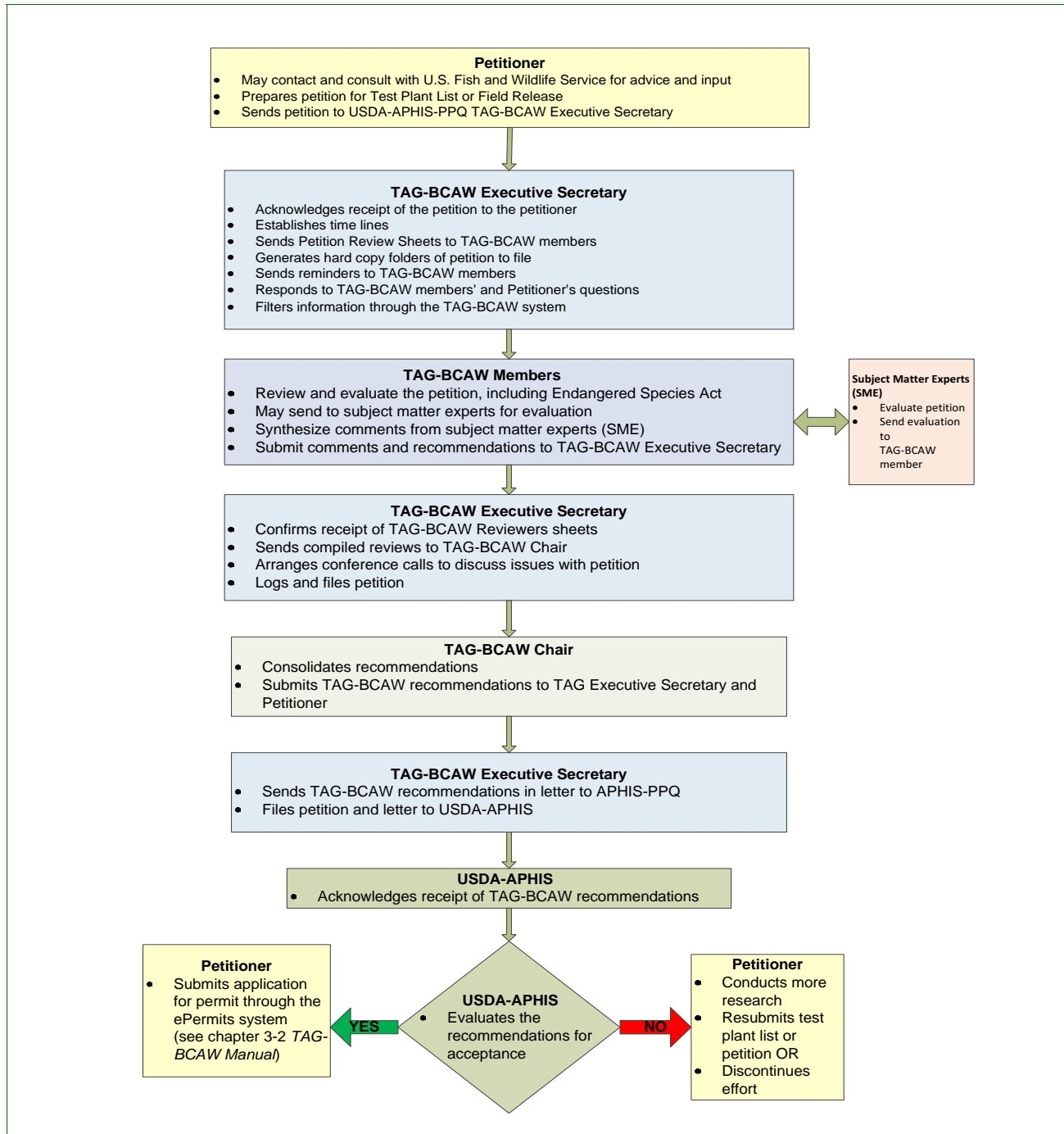


Figure 3-1-1 TAG-BCAW Petition for Field Release or Test Plant List Flow Chart

# Petitions and Permitting

## *APHIS Permitting Process*

---

### Content

Introduction	<b>3-2-1</b>
Permitting Process for Weed Biological Agents	<b>3-2-2</b>
Step 1: Early Input	<b>3-2-2</b>
Step 2: Applying for APHIS Permits for Importation	<b>3-2-3</b>
Step 3: APHIS Responses to the Recommendation Letter from the TAG-BCAW Chair	<b>3-2-5</b>
Step 4: Environmental Compliance in Support of Petition for Release	<b>3-2-6</b>
Step 5: Compliance With Executive Order 13175	<b>3-2-8</b>

---

### Introduction

The *APHIS Permitting Process* section of the *Petitions and Permitting* chapter provides information about APHIS' role in each step of the review process for petitions submitted to the TAG-BCAW for the release of proposed biological control agents of weeds, and the flow of documents used by APHIS when considering whether to issue a permit for the release of such nonindigenous organisms.

APHIS has authority to regulate the importation and interstate movement and release of biological control organisms (because they may potentially present a plant pest risk), noxious weeds, and plant pests under the Plant Protection Act of 2000. APHIS regulates the movement of these organisms in order to prevent the dissemination of plant pests or noxious weeds. These regulations may be found in the [Code of Federal Regulations](#) Chapter 7 Part 330.

## Permitting Process for Weed Biological Agents

The Plant Protection Act of 2000 (7 U.S.C. 7701 *et seq.*) provides the Secretary of Agriculture with the authority to regulate “any enemy, antagonist, or competitor used to control a plant pest or noxious weed” that poses a potential plant pest risk. APHIS regulates biocontrol organisms because they are plant pests. Before issuing a permit to release a biocontrol organism into the environment, APHIS must comply with the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq.*), the Endangered Species Act (ESA) (16 U.S.C. 1531 *et seq.*), and Executive Orders (EO) 13112 (64 FR 6183) for Invasive Species and EO 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations.”

TAG-BCAW petitioners may refer to the following pages that describe the content and flow of documents used by APHIS to meet the requirements of the Acts and Executive Orders which includes APHIS’ responsibility for the issuance of such permits. An understanding of the various documents APHIS prepares and or reviews conducted should help to clarify this process.

### Step 1: Early Input

Researchers should submit a proposed test plant list to the Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW) whether or **not** a proposed biological control agent has yet been identified. The TAG-BCAW, an interagency group, was established to advise weed biological control researchers and to provide the APHIS-PPQ Pest Permitting Branch with a recommendation on the proposed Federal action, issuance of a permit authorizing release to the environment. At this early stage of the review process, TAG-BCAW makes recommendations on the target weed choices and comments on the proposed test plant list for host specificity testing.

Both TAG-BCAW reviewers and researchers should review Federal and State lists of threatened and endangered species prior to host specificity testing. All threatened and endangered species should be considered when designing the test plant list. Candidate species and species proposed for listing should also be considered because they may be listed at any time. Web sites to obtain information on listed species include [http://ecos.fws.gov/tess\\_public/](http://ecos.fws.gov/tess_public/) and <http://ecos.fws.gov/ecos/indexPublic.do>. Even though a U.S. Fish and Wildlife Service (USFWS) representative participates on the TAG-BCAW review panel, this **does not** substitute for the ESA consultation process.

Petitioners are encouraged to contact the regional offices and local field offices of the USFWS in the areas where the target weed is located, prior to and during the host testing phase in order to obtain advice and guidance regarding any threatened, endangered, or proposed species. The USFWS can also provide

guidance regarding obtaining seeds or samples of these plants or related species that can serve as surrogates for these species.

## Step 2: Applying for APHIS Permits for Importation

Permits are required from APHIS for any of the following situations:

- ◆ Importation of live biological control organisms into the United States and its Territories (see [PPQ 526 Permit for Importation](#));
- ◆ Interstate movement of live biological control organisms (includes movement between any State, territory and the District of Columbia) (see [PPQ 526 Permit for Interstate Movement](#) on page 3-4);
- ◆ Retaining live biological control organisms in containment facilities after expiration of a permit (see [PPQ 526 Permit for Continued Curation](#) on page 3-4); and
- ◆ Movement of any live biological control organism from the confines of a containment facility to any other containment facility or for environmental release (see [PPQ 526 Permit for Removal from Containment](#) on page 3-4).

All conditions of any permit, including all authorizations and restrictions, remain binding as long as the permit is valid and prior to expiry. Revocation or expiration of any permit requiring containment for the regulated organisms requires devitalization or destruction of all organisms regulated by that permit, or a new permit for the organisms.

Guidance and step-by-step instructions for obtaining each of these types of PPQ 526 permits can be found at <https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits/regulated-organism-and-soil-permits> and <https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits/regulated-organism-and-soil-permits/biological-control-organism-permits>.

### PPQ 526 Permit for Importation

A PPQ 526 Permit for Importation is needed every time live biological control organisms are imported into the United States and its Territories. A PPQ 526 Permit will require an USDA-APHIS inspection containment facility as the destination, unless the organisms being imported are species having certain exemptions under APHIS regulations 7 CFR 330.200 *et seq.*

Additional information concerning containment facilities can be found at <https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits/plant-pests/containment>.

### **PPQ 526 Permit for Interstate Movement**

A PPQ 526 Permit for Interstate Movement is needed every time live weed biological control organisms are moved across State lines between any State of the United States and its Territories. A PPQ 526 permit is required regardless of the use (research, release, etc.). There may be exceptions to the requirement for an interstate movement permit for certain biological control organisms.

### **PPQ 526 Permit for Continued Curation**

A PPQ 526 Permit for Continued Curation is required in order to retain live regulated organisms in containment beyond the expiration of any PPQ 526 permit that requires containment. When continued movement is involved, colonies/cultures of organisms may be kept under a new PPQ 526 Permit for importation or interstate movement when renewed.

### **PPQ 526 Permit for Removal from Containment**

A PPQ 526 Permit for Removal from Containment is required in order to move any live regulated organisms from the confines of an APHIS inspected containment for any reason, including movement between containment facilities regardless of their relative location (in addition to such movements which may be described and permitted in the existing permit).

If movement between specific containment facilities is already described and permitted in an existing PPQ 526 Permit for importation, interstate movement, or continued curation, then an additional 526 Permit is **not** required for such movement.

A PPQ 526 Permit is required to remove a regulated weed biological organism from containment and enables release into the environment after the APHIS approval, following the processes described in [Step 3: APHIS Responses to the Recommendation Letter from the TAG-BCAW Chair](#) on page 3-5 and [Step 4: Environmental Compliance in Support of Petition for Release](#) on page 3-6.

#### **NOTICE**

Keep in mind that any removal from containment **without** safeguards (i.e., escape-proof packaging while moving to another containment facility or a physically separate part of a containment facility) constitutes release into the environment.



### Step 3: APHIS Responses to the Recommendation Letter from the TAG-BCAW Chair

After receiving the TAG-BCAW's recommendation, APHIS reviews the recommendation, including reviewers' comments and any information cited by reviewers, and any additional information available to APHIS in order to determine if APHIS will support release of the biological control agent. The decision by APHIS to support - or **not** support - release may or may not agree with the TAG-BCAW's recommendation to release (or **not** release), based on all the information APHIS considers. However, historically the TAG-BCAW's recommendation and the subsequent APHIS decision regarding release frequently coincide.

Soon after receipt of the recommendation letter from the TAG-BCAW Chair, APHIS typically writes a letter to inform the Petitioner of the APHIS decision regarding support of the request to release the biological control agent, with a copy to the TAG-BCAW Executive Secretary.

In the cases where APHIS supports the request to release, APHIS may still request that the petitioner provide additional information or clarification, which will be used to support and enhance the environmental compliance documents in the following steps. This additional information or clarification is usually in response to questions or concerns raised by the reviewers or other parties which are often received even with a TAG-BCAW recommendation for release.

When APHIS supports a request for release, the Petitioner may submit an application for removal from containment and environmental release of the biological control agent. See [PPQ 526 Permit for Removal from Containment](#) on page 3-4.

#### NOTICE

An application may be submitted by any individual in accordance with APHIS regulations (7 CFR 330.201 through 330.203), and may be from a party who is **not** the petitioner or researcher, but who is proposing to colonize, increase, or distribute the agent. Upon receipt of the application, APHIS will proceed with the environmental compliance process described in [Step 4: Environmental Compliance in Support of Petition for Release](#) on page 3-6.

When release of the weed biological control agent is **not** supported by APHIS, then APHIS will convey the reasons for **not** supporting release in the letter to the Petitioner, and may outline steps to take if the Petitioner wishes to improve the petition. At this point, the decision of the Petitioner or other researchers will be whether to invest additional time and resources to improving the petition and submitting an amended petition to the TAG-BCAW Executive Secretary. The subsequent submission of a new or an amended petition may or

may **not** lead to a recommendation for release or support for release by APHIS. APHIS will deny the application submitted for removal from containment and therefore will **not** proceed with the environmental compliance process described in [Step 4: Environmental Compliance in Support of Petition for Release](#).

### **Step 4: Environmental Compliance in Support of Petition for Release**

Issuance of permits by APHIS for the environmental release of nonindigenous weed biological control organisms is considered a Federal action and triggers compliance with the Endangered Species Act (ESA) and the National Environmental Policy Act (NEPA). Steps and procedures APHIS follows to comply with these Acts regarding the proposed release of biological control agent against weeds are described in [Compliance with the Endangered Species Act \(ESA\)](#) and [Compliance with the National Environmental Policy Act \(NEPA\)](#).

The petitioner should apply for a PPQ 526 Permit to remove a weed biological control organism from containment (see [PPQ 526 Permit for Removal from Containment](#) on page 3-4) after receipt of a letter from APHIS indicating support of the request to release the weed biological control organisms into the environment of the United States. APHIS proceeds with the steps for environmental compliance with these environmental Acts in response to receipt of the application for the permit to release (removal from containment).

#### **Compliance with the Endangered Species Act (ESA)**

According to the ESA, any action that is authorized, funded, or carried out by a Federal Agency **must** comply with the consultation requirements of Section 7 of the ESA. (See [Section 7 Consultations](#) on page 6-1 and [ESA Compliance](#) on page 6-1.) Although the researcher should have received input from the USFWS or possibly the National Marine Fisheries Service from the beginning, APHIS-PPQ determines if consultation with the USFWS or possibly the National Marine Fisheries Service **must** be conducted at this point in the process. If the proposed release will have **no** effect on listed species or designated critical habitat, then **no** consultation with the USFWS or the National Marine Fisheries Service is required.

Informal consultation with the USFWS or possibly the National Marine Fisheries Service occurs when the release of the biological control organism “may affect, but is **not** likely to adversely affect” listed species or designated critical habitat.

The document required for Section 7 consultation with the Services is a biological assessment (BA). This document is prepared by APHIS and is submitted to the USFWS or possibly the National Marine Fisheries Service.

The BA includes several elements:

1. A description of the action to be considered.
2. A description of the specific area that may be affected by the action.
3. A description of any listed species or critical habitat affected by the action.
4. A description of the manner in which the action may affect any listed species or critical habitat and an analysis of any cumulative effects.
5. Relevant reports, including any EA or EIS.
6. Other relevant information on the action, affected listed species, or critical habitat.

The USFWS reviews the BA, and if they concur with the “may affect, **not** likely to adversely affect” determination, then USFWS will send APHIS a concurrence letter and the consultation process is complete. Once complete, APHIS incorporates the concurrence from USFWS into the environmental assessment (EA), and makes any final changes necessary.

In very rare cases, APHIS may pursue formal consultation with the USFWS. Formal consultation is required when APHIS determines that the proposed release “may affect and is likely to adversely affect” listed species or designated critical habitat. Typically, APHIS **does not** proceed with formal consultation **except** under the unusual circumstances, where the adverse effect may be in doubt, or is likely to be very limited.

### **Compliance with the National Environmental Policy Act (NEPA)**

The document required for National Environmental Policy Act (NEPA) compliance is the environmental assessment (EA), a concise public document that provides evidence and analysis to determine whether a Finding of No Significant Impact (FONSI) can be reached. The EA is prepared by APHIS staff scientists. The EA provides the public with the potential positive and negative environmental impacts, both direct and indirect, that may occur following release into the environment. Petitioners from other Federal agencies **must** also consider their own NEPA implementing procedures specific to any proposed actions.

Once the EA has been completed, APHIS-PPQ publishes a 30-day notice of availability of the EA in the [Federal Register](#) to allow public comment on the proposed action. After considering the comments, APHIS does **one** of the following:

- ◆ Reaches a finding of **no** significant impact (FONSI); or
- ◆ Is unable to reach a FONSI and concludes that preparation of an environmental impact statement (EIS) is required. An EIS is a document prepared in compliance with NEPA when significant impacts are expected from the proposed action

If a FONSI has been reached, APHIS will publish the availability of the FONSI in the [Federal Register](#) and post the final EA and FONSI on the [APHIS Plant Health Environmental Assessments Web site](#) [https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/ea/ct\\_plant\\_health\\_environmental\\_assessments](https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/ea/ct_plant_health_environmental_assessments).

### **Step 5: Compliance With Executive Order 13175**

APHIS, like other Federal Agencies, is bound to comply with various Executive Orders (EO), some of which apply to these proposed actions. EO 13175, Consultation and Coordination with Indian Tribal Governments, was issued to ensure that there would be meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications. Therefore, APHIS implements contact and communication with Federally-recognized tribal governments regarding the proposed environmental release of weed biological control organisms.

Typically, prior to the publication of the EA in the [Federal Register](#), APHIS staff prepares a letter describing the proposed Federal action and requests review and input from Native American Tribes in any area likely to be inhabited or affected by the release of the proposed biological control agent against weeds. If the tribal government requests consultation with APHIS, environmental compliance and other actions in preparation of the proposed release are paused until consultation is concluded.

# Biological Control of Weeds

## *Introduction*

---

### Contents

Introduction 4-1-1

Biological Control 4-1-1

Risk Analysis of Biological Control Agents of Weeds 4-1-3

---

### Introduction

The *Introduction* section of the *Biological Control of Weeds* chapter provides a brief introduction to biological control.

---

### Biological Control

Classical biological control of weeds is a weed control method where exotic natural enemies are used to reduce exotic weed infestations. The practice of weed biological control in the United States began in the 1940s and has resulted in some spectacular successes in the suppression of the targeted weed. One of the earliest and best known examples is the introduction of *Chrysolina* leaf beetles for control of Klamath weed, a poisonous weed that invaded dairy pastures and rangelands in the western United States and Canada. Classical weed biological control of weeds has also resulted in a number of situations where the exotic control agent becomes established, but fails to suppress the target weed.

Several different kinds of organisms have been used as biological control agents of weeds: insects, mites, nematodes, and plant pathogens; of these, herbivorous insects are the most common weed biological control agent.

Efforts to develop a weed biological control agent consist of the following steps:

1. Foreign exploration in the weed's area of origin.
2. Host specificity studies.
3. Approval of the exotic agent by government regulatory authorities.
4. Release and establishment in areas invaded by the target weed.
5. Post-release monitoring.

Biological control is one of the many weed management options used alone or combined with other management approaches. The use of biological control agents of weeds may be the preferred or **only** tool available in some habitats or situations, although chemical, cultural, and mechanical options have their place, too. Many land managers, ranchers, and farmers use an integrated weed management approach, combining more than one method to control weeds.

TAG-BCAW's mission statement is, "To facilitate proposed biological control agents of weeds in North America by providing guidance to researchers and recommendations to regulating Agencies for or against release of nonindigenous biological control agents of weeds. This is based on considerations of potential nontarget impacts, conflicts of interest, natural resources, agricultural production, and the Endangered Species Act (ESA) Threatened and Endangered Species List." The TAG-BCAW's role in the development of a classical weed biological control agent is to review the information obtained during the host specificity studies and provide a recommendation to the USDA-APHIS-PPQ as to the proposed biological control agent of weeds and its potential for non-target impacts.

The ecological implications of managing exotic species with exotic biocontrol agents intentionally introduced from the native range of the target weeds **must** be thoroughly evaluated before release. Potential risks are systematically evaluated using established, standardized protocols that yield repeatable, scientifically valid and conclusive data.

Historically, biological control has been most effective against large infestations of a single weed species, and has been most successful on weeds that have been introduced into areas where co-evolved natural enemies **do not** occur.

Biological control has several advantages over other types of weed control (Wapshere, et al., 1989). These advantages include long-term or sustained management of the target plant, limited treatment side-effects or nontarget effects, attack restricted to one or a few very-closely related weed species, self-perpetuating agents, and nonrecurring costs.

TAG-BCAW plays a role in evaluating the introduction an exotic organism to control weed infestations by objectively weighing such advantages against potential non-target impacts and conflicts of interest.

Wapshere et.al.'s (1989) article "Recent Developments in Biological Control of Weeds" (see [References](#) on page 4-3), provides a review, examples, and a discussion of the advantages and disadvantages of different approaches to biological control of weeds, such as classical, augmentative, inundative, or conservation approaches.

## **Risk Analysis of Biological Control Agents of Weeds**

The aim of host specificity and other pre-release studies of a proposed biological control agent are to produce a body of information for regulatory authorities to perform an ecological risk analysis of the potential for direct damage to economic and native non-target plant species following release of the control agent. Risk analysis consists of three elements: hazard identification, analysis of exposure, and analysis of probability. Hazard identification is achieved through the host specificity testing where the different life stages of the proposed biological control agent that pose the threat are identified and the agent's fundamental host range is described. Analyses of exposure and probability are based on the predicted field host range following release and the predicted actual damage to non-target species.

The fundamental host range of a species is the absolute limit of its host range and is genetically determined. The field host range is the subset of hosts used by a species following its release into the environment and will vary with availability of hosts (e.g., geographic allopatry, host synchrony), genetic variation in host vulnerability (e.g., defense chemicals), and the behavior and physiology of the control agent. The fundamental host range can be defined using no-choice or starvation tests in which a proposed biological control agent is exposed to a non-target plant which **must** be utilized or the agent dies. Information on the field host range is predicted from results obtained during choice tests in the laboratory and in the field. Based on the results of all tests and other behavioral and life history observations, predictions are made on the likelihood that a potential agent will damage a particular plant or group of plants in the environment it is to be released.

### **References**

For more information about biological control of weeds, refer to the following listed references as well as those listed in [Biological Control of Weeds](#) on page F-10.

- Charudattan, R.; Walker, H.L., eds. 1982. *Biological Control of Weeds with Plant Pathogens*. New York, NY: John Wiley & Sons, Inc.
- Hoddle, M.S. 2004. Restoring balance: Using exotic species to control invasive exotic species. *Conservation Biology* 18: 38-49.
- McFadyen, R.E. 1998. Biological Control of Weeds. *Annual Review of Entomology* 43: 369-393.
- TeBeest, D.O., ed. 1991. *Microbial Control of Weeds*. New York, NY: Chapman and Hall.
- Van Dreische, R.; Hottle, M; Center, T. 2008. *Control of Pests and Weeds by Natural Enemies: An Introduction to Biological Control*. Blackwell Publishing Ltd.
- Wapshere, A.J.; Delfosse, E.S.; Cullen, J.M. 1989. Recent developments in biological control of weeds. *Crop Protection* 8: 227-250.

**Biological Control of Weeds**

Risk Analysis of Biological Control Agents of Weeds

---



# Biological Control of Weeds

## *Identification and Characterization of Agents*

---

### Contents

Introduction	4-2-1
Identification and Characterization of Proposed Biological Control Agents of Weeds	4-2-1
Approaches, Methods, and Tools for Identification and Characterization of the Agent	4-2-4
Taxonomic Approaches	4-2-4
Morphological Methods	4-2-4
Functional Analysis	4-2-5
Molecular or Genetic Tools	4-2-5
Cryptic or Sibling Species	4-2-7
Challenges	4-2-7
Experts	4-2-8
Reference Collections	4-2-8

---

### Introduction

The *Identification and Characterization of Agents* section of the *Biological Control of Weeds* chapter provides information that is intended for and is pertinent to all classes of agents, including arthropods, plant pathogens, and nematodes.

---

### Identification and Characterization of Proposed Biological Control Agents of Weeds

Successful classical biological control of weeds requires accurate identification and characterization (biological, chemical, ecological, and phylogenetic) of the proposed biological control agent of weeds.

Target and agent identification and characterization are critical because they have the potential to do the following:

- ◆ Affect future evaluation processes
- ◆ Influence future assessments of risk
- ◆ Provide a gateway to knowledge through published literature and reports

- ◆ Preclude introduction of unapproved organisms

Both petitioners and the TAG-BCAW reviewers should consider the following questions when describing an agent:

- ◆ What is the agent? (e.g., insect, mite, fungus, bacterium, virus, nematode)
- ◆ What is the life cycle of the agent?
- ◆ What other information (e.g., biological, chemical, ecological) should be known about the agent?
- ◆ Why is this information needed?
- ◆ What type of information about the identification and characterization of the agent needs to be documented in the petition?
- ◆ How can pertinent information be best conveyed to others?

There are many complex questions associated with the identification and characterization of proposed biological control agents of weeds, target weeds, and close relatives of both. Addressing these requires highly-specialized technical expertise. TAG-BCAW members who are unfamiliar with certain subject areas are encouraged to consult with experts for additional help in verifying information presented in petitions.

Some of the complex questions associated with the identity and characterization of an agent are as follows:

- ◆ What is the scientific name of the agent (at minimum, genus and species)? Who determined the name (i.e., taxonomic authority)? What is the level of confidence of this determination?
- ◆ How is the agent related to other taxonomic groups?
- ◆ Are the voucher specimens deposited in a national museum where they are accessible to scholars and international experts?
- ◆ Does the agent (or a closely-related species) already occur in areas likely to be the targeted for agent release?
- ◆ Can the agent be differentiated below the species level and if so is it currently resolved and uncontested?
- ◆ Can the agent's presence post-release be unambiguously confirmed (e.g., based on sampling evidence that the natural enemy is present, and feeding damage to host plants)?

- ◆ How does the agent affect the target weed (e.g., defoliation, stem or root galling, seed destruction, etc.), and is damage caused by a specific life stage of the agent?
- ◆ Are the agent's intensity and scale (individual, patch, or population level) of damage on the target weed well characterized?

## Approaches, Methods, and Tools for Identification and Characterization of the Agent

Researchers use a variety of approaches, methods, and tools to identify and characterize biological control agents of weeds. A critical challenge for the TAG-BCAW is determining if the approaches, methods, and tools employed confer an appropriate level of confidence in identifications and characterizations. What is the evidence? How is the evidence presented?

### Taxonomic Approaches

For proposed biological control agents of weeds, taxonomic identification **must** be provided at minimum to the species level. In some cases, identification below the species level may be necessary. For many microbial groups, sexual and asexual forms exist for a given species. Taxonomy may be based on spore forms or other reproductive characteristics. For other groups, biotypes, genotypes, strains, pathotypes, and subspecies exist. These sub-taxa are characterized in different ways; for example, some may refer to isolates. Isolates are often limited collections made from a specific location, and may **not** represent the entire genetic diversity of the species. Accuracy in naming potential biological control agents of weeds is as important as accurate characterization (biological, chemical, ecological).

### Morphological Methods

Conventional morphological methods are often initially used to determine species identity. Physical attributes unique to the species are used to generate a diagnosis that can be used to distinguish the agent from close relatives once it has been released.

Attributes may include:

- ◆ Armature (spine, hairs)
- ◆ Body shape and size
- ◆ Color patterns
- ◆ Cuticle surface
- ◆ Internal Structures (stylet, reproductive organs, etc.)
- ◆ Morphometric parameters
- ◆ Physiological (spiracles, pores) structures
- ◆ Reproductive structures
- ◆ Shape and number of appendage (antennae, legs, palpi, etc.) segments

## Functional Analysis

Functional analysis of characteristics, such as part of the host plant utilized, feeding behavior, or infection parameters can also be incorporated into the identification of an agent. In some cases, these methods can provide a more accurate way to identify an agent.

**EXAMPLE** For example, plant galling arthropods are typically identified from the location (on host plant) and unique morphology of the galls; this approach provides a more certain yet simple identification of the arthropod species than the morphological traits of the arthropod species itself.

Other methods for characterizing an agent involve biological or chemical characterization using a range of available tools.

In some cases, assessments of agent identity **must** extend beyond taxonomy to include the following biological and chemical characterizations:

- ◆ Biological traits such as growth on selective media (microbes), phenology, diapause;
- ◆ Enzymatic reactions and other chemical analyses;
- ◆ Host indexing for characterizing pathogens;
- ◆ Disease symptoms/damage patterns;
- ◆ Hybridization studies and evaluation of reproductive strategies employed by an agent; and
- ◆ Range location and relationship to other ecotypes.

## Molecular or Genetic Tools

Identification and characterization of an agent using molecular or genetic tools yields more definitive agent identification and can significantly enhance or reveal complex agent characterizations.

A number of techniques have been used to identify biological control agents:

- ◆ Allozymes and proteins: compare data between geographical isolates;
- ◆ Amplified fragment length polymorphism (AFLP) and Selective Amplification of Microsatellite Polymorphic Loci (SAMPL): assess variation among individuals of the same species;
- ◆ DNA bar-coding;
- ◆ DNA sequencing: differentiate species and populations;
- ◆ Multiple Arbitrary Amplicon Profiling (MAAP): assess variation among individuals of the same species; includes RAPD, ISSRs, UP\_PCR, DAF techniques;

- ◆ Microsatellites or Simple Sequence Repeats (SSRs): differentiate species and populations;
- ◆ Polymerase chain reaction (PCR): qualitative and quantitative (qPCR) detection of species; and
- ◆ Restriction fragment length polymorphism (RFLP): differentiate between closely-related taxa.

Sequencing of diagnostic rDNA regions is now preferred as fast and accurate and decreasing costs. DNA bar-coding uses molecular markers such as COI, CO IIITS, 12S rRNA, 16S rRNA, 18S rRNA, 28S rRNA, and heat shock protein 90 (hsp90), and will distinguish most species, including cryptic species, immature stages, and unknown species. Sequencing technology is rapidly developing. Second generation techniques such as pyrosequencing, sequencing by synthesis and sequencing by ligation are vast improvements on first generation or Sanger sequencing. Third generation techniques are already under development. Molecular data provides the capacity to label agents for later verification.

---

## Challenges

The TAG-BCAW is continually challenged to accurately assess the petitioners' identification and characterization of proposed biological control agents of weeds.

Species identifications or characterizations presented in petitions or test lists may be incorrect. When this occurs, implications are as follows:

- ◆ Hampering of access to published information may be due to incomplete names;
- ◆ Loss of effort thus far invested toward biologically controlling weeds;
- ◆ Misguided sense of confidence using a knowledge base that is inappropriate to the proposed biological control agent of weeds being studied; and
- ◆ Potential to improperly assess the risk factors.

### Cryptic or Sibling Species

The presence of cryptic or sibling species in shipments of proposed agents received in containment facilities may go unnoticed, depending upon taxonomic status of the group involved. Cryptic or sibling species can cause serious problems in host plant testing, resulting in inaccurate or erroneous assessments of host range and in quarantine operations after the research has been completed and the agent has been approved for release.

In this situation, the wrong or untested species may be included in environmental releases.

**EXAMPLE** Populations collected from a geographically distant part of a tested agent's range may prove to be a different species, even though the populations appear to be similar.

The unintentional release of cryptic or sibling species has been documented in existing North American weed biological control programs. Researchers and TAG-BCAW reviewers alike can prevent this problem by questioning whether such possibilities might exist in the reported identification process.

## Experts

What is an expert? Does the expert have the appropriate breadth of knowledge? Who are the world authorities? What is the expertise of the person who is describing the characterization? **Not** all experts agree, so there may be some confusion relying on them. Since world authorities are **not always** accessible and may **lack** critical knowledge of certain groups, definitive identification is **not always** possible. It is therefore extremely important that individuals of the species approved for release **always** come from the same population tested with a reference collection made of individuals from the population released (see below).

## Reference Collections

Reference collections support biological control and hold specimens of proposed biological control agents that have been studied by taxonomists. In some cases, access to reference collections is limited, since collections may be located in foreign museums. Reference collections and hands-on experience may be limited to geographic regions. If these geographic regions fall outside of the main region being studied by taxonomic experts, then the experts may have limited capacity to identify exotic agents.

**EXAMPLE** Agents from the southern hemisphere and from locations in the Old World may **not** be represented in U.S. reference collections; therefore, definitive identification may **not** be possible by U.S. taxonomists.

As required by NAPPO RSPM No. 7, a reference collection of 10 or more individuals from the released population **must** be deposited in a national collection. It is recommended that the specimens be deposited in national collections of Canada, Mexico, and the United States to ensure that the experts in North America conducting future taxonomic studies have access to, and include representatives of the biological control agent. Specimens should be of good condition for DNA extraction and with clear labels indicating collection locality, latitude and longitude, date of collection, name of collector, and any other pertinent information. A letter explaining that the specimens are biological control agents and are being donated to the National Collection as part of the conditions under which release will be granted should accompany the specimens when they are submitted. A copy of the letter should be included in the petition submission to TAG-BCAW.

See [Table 4-2-1](#) for National Collections for Specimens.



Table 4-2-1 National Collections for Specimens

Country	Designated Collection Manager Contact Information	
United States of America	Dr. Floyd Shockley, Acting Collections Manager National Museum of Natural History Smithsonian Institution PO Box 37012, MRC 165, Room CE-419 Washington, DC 20013-7012 United States of America	Phone: 202-633-0990 Fax: 202-786-2894 <a href="mailto:shockleyf@si.edu">shockleyf@si.edu</a>
Canada	Dr. Owen Lonsdale, Collections Manager Canadian National Collection of Insects, Arachnids and Nematodes Agriculture and Agri-Food Canada/Agriculture et Agroalimentaire Canada KW Neatby Building 960 Carling Avenue Ottawa, ON K1A 0C6 Canada	Phone: 613-759-1992 Fax: 613-759-1927 <a href="mailto:owen.lonsdale@agr.gc.ca">owen.lonsdale@agr.gc.ca</a>
Mexico	Christina Mayorga Martinez Instituto de Biología - UNAM Departamento de Zoología 3er Circuito Exterior s/n Ciudad Universitaria Alcaldía Coyoacán 04510 Ciudad de México México	Phone: 55 22 57 17 99 <a href="mailto:mayorgac@ib.unam.mx">mayorgac@ib.unam.mx</a>

### Taxonomic Authority

The petitioner **must** include the name of the recognized taxonomic authority in that particular taxon. If the name of the agent species is **not** listed, then the petitioner **must** include a letter from the expert taxonomist in the particular taxon so stating. Taxonomists may be reluctant to go on record with determinations unless they have a high level of confidence in their assessment. The use of incomplete names is **not** necessarily a limitation, since much of the assessment is based on biological information obtained after collection.

Has the taxonomic authority done historical research on the taxonomy of the relevant taxon? Minor frustrations may occur in assessing the knowledge base because of synonymies (process), revisions to new genera, and other changes in the names by which information on agents is retrieved.

### References

For more information about identification and characterization of agents, see [References](#) on page F-1.

Abebe, E.; Mekete, T.; Thomas, W.K. 2011. A critique of current methods in nematode taxonomy. *African Journal of Biotechnology* 10: 312-323.

Gaskin, J.F.; Bon, M-C.; Cock, M.J.W.; Cristofaro, M.; De Biase, A.; De Clerck-Floate, R.; Ellison, C.A.; Hinz, H.L.; Hufbauer, R.A.; Julien, M.H.; Sforza, R. 2011. Applying molecular-based approaches to classical biological control of weeds. *Biological Control* 58:1-21.

NAPPO (North American Plant Protection Organization). 2015. Guidelines for Petition for First Release of Non-indigenous Phytophagous or Phytopathogenic Biological Control Agents. *Regional Standard for Phytosanitary Measures (RSPM) No. 7*. Available at: [https://www.nappo.org/application/files/5315/8352/2957/RSPM\\_07-30-07-15-e.pdf](https://www.nappo.org/application/files/5315/8352/2957/RSPM_07-30-07-15-e.pdf)

# Biological Control of Weeds

## *Host Specificity Testing of Arthropods*

---

### Contents

Introduction	4-3-1
Host Plant Selection	4-3-2
Host Specificity Testing	4-3-2
Rigidity of Arthropod Behavior: Importance to Host Specificity Testing	4-3-3
Screening Tests	4-3-4
No-choice Plant Tests	4-3-5
Multiple-choice Plant Tests	4-3-6
Oviposition Testing	4-3-6
Field Testing	4-3-7
Experimental Design	4-3-8

---

### Introduction

The *Host Specificity Testing of Arthropods* section of the *Biological Control of Weeds* chapter provides the guidelines for host specificity testing of all arthropod species that are potential classical biological control agents of weeds. These guidelines **must** be read and comprehensively understood by all TAG-BCAW members that review and evaluate petitions submitted for environmental releases of new proposed biological control agents of weeds (i.e., species **not** previously screened and then approved for environmental release).

The sequence of tests described here is an example, and is **not** intended to serve as a definitive checklist. Details of any host specificity tests vary according to the biology and life history of each proposed species. When reviewing the methods section of a petition, evaluate if the petitioner has used an appropriate method for studying the host range of the species.

---

## Host Plant Selection

A strategy based on the Wapshere centrifugal method for selecting plants for host specificity testing is covered under [Test Plant Lists](#) on page 5-1. Briese proposed a more advanced approach that uses plant molecular systematics in test plant species choice. Alternative host plant selection strategies may also be used.

The identity of the plants **must** be confirmed, the person identifying the plants **must** be named, and the source of propagative material **must** be clearly stated. The centrifugal testing approach may **not** be appropriate for all organisms, particularly facultative saprophytes (i.e., culturable organisms), thus criteria for selecting test plant species should be clearly stated.

---

## Host Specificity Testing

Host specificity testing is the process of rigorously evaluating a proposed species to determine its field host range. The field host range consists of those plants on which all individuals of the species would consistently develop normally and complete their life cycle in nature. Host specificity testing of proposed arthropod agents begins with field studies of the species when initially discovered in the native range on the target weed.

Once a potential agent has been found feeding on the target weed in the field, the first step is usually to survey the surrounding plants, particularly those in the same family as the target weed. This type of survey can give the researcher a preliminary indication of whether the arthropod is a generalist or specialist herbivore. Similarly, once the species is identified, a literature search will often indicate if the arthropod is likely to have too broad a host range to be considered as a proposed biological control agent of weeds. Species confirmed to be generalist feeders or those with a broad host range are dropped from further consideration. Researchers then focus their efforts on evaluating more promising potential agents under controlled environmental conditions. This evaluation determines if the proposed species' host range is limited enough to make it a feasible biological control agent.

**No** set protocol or standard procedure is routinely used for host specificity testing. Different tests **must** be developed and implemented for each proposed species, depending upon feeding behavior or the part of the plant on which it feeds.

The individuals used in host specificity testing may be from wild populations collected in the field or from laboratory-reared colonies. Both sources have

advantages and disadvantages which can ultimately affect the results of host specificity testing.

For some species, field-collected material is frequently more readily attainable and cheaper to use than trying to establish and maintain a laboratory colony. A disadvantage of using field-collected individuals is that they may be contaminated with diseases or parasitoids which could ultimately affect their behavior. Furthermore, a researcher is less able to control for age and vigor of field-collected material (e.g., females may already have laid most of their eggs at the time of collection).

Laboratory-reared individuals are easier to control and provide a better opportunity for researchers to observe the arthropod's biology and life history attributes more closely. In addition, laboratory colonies, compared to wild populations, provide a more genetically homogeneous population to work with that is free of diseases and parasites. Unfortunately, laboratory colonies can undergo genetic bottlenecks resulting in behavioral changes or loss of vigor, particularly if the individuals are continuously reared on artificial diets or the colonies are continuously reared through numerous generations. This can be mitigated by periodically introducing field-collected individuals sourced from the original collecting location to laboratory colonies, or by maintaining separate genetic lines of the agent which are periodically crossed to sustain genetic diversity and colony vigor.

Natural populations of a proposed species may be quite small or available **only** for very limited periods of time, while laboratory-reared colonies can provide a large and constant year-round supply of experimental subjects.

In general, proposed species selected for screening or starting a rearing colony should originate from a single and clearly-defined collection site. This ensures that the population of an agent that is to be released retains the same genetic diversity and characteristics as the population that was tested.

### **Rigidity of Arthropod Behavior: Importance to Host Specificity Testing**

As arthropods select host plants and feed on them, they appear to transition smoothly from one behavior to another—walking, stopping, and feeding just as mammals do. Nonetheless, arthropod behavior is generally much less fluid than that of mammals. Insects and mites find, preliminarily assess, then select and feed on hosts in a series of discrete steps, each step mediated by a particular physical or chemical stimulus. In some cases, serio-chemical cues **must** be present for the arthropod to sustain its feeding behavior. If critical stimulus is lacking, then host selection or feeding may be aborted triggering a different behavior, such as flying away to search for another plant.

**Not** all arthropods have the same sequence of behaviors. Certain steps displayed by one species may **not** be displayed by another. Nevertheless, arthropod behavior is generally considered to be rigid, at least at the gender and life stage within the species level, and this rigidity constitutes an important basis for scientists' confidence in the results of host specificity tests. Under both natural (unmanipulated) field and controlled experimental test conditions, genetically-determined behaviors prevent arthropods from skipping over steps in order to satisfy their need for food.

Immature arthropods usually have host plants selected for them by ovipositing adults. Immature arthropods may therefore have relatively under-developed host discrimination abilities. When arthropods deposit eggs on unsuitable host plants, larvae may or may **not** still attempt to feed. If the host plant is of poor nutritional quality or possesses defensive chemicals, then larvae either may either grow and develop for a time but fail to complete development, or they may complete development but emerge as undersized adults. The production of undersized adults can be indicative of additional deleterious physiological effects; affected adults may also be sterile or less fecund. For some species, such as many root feeders, larvae are able to seek out suitable hosts, so host selection for oviposition is likely more random.

### **Screening Tests**

Current practices involve a tiered approach to non-target testing. The general sequence is no-choice tests on as many test plant list species as possible, followed by multiple choice tests (agent simultaneously exposed to one or more non-target species and the target weed). Tests use standardized observations of feeding or oviposition and measures of development to compare acceptance and suitability of target and non-target plant species. Researchers should strive to conduct tests on the biologically and ecologically relevant phenological stages of test plants. Final testing of the most promising proposed biological agents of weeds is frequently conducted in field cages or as open field tests in the agents' and target weeds' country of origin.

## No-choice Plant Tests

During the initial stage of evaluation, all species identified on the test plant list (see [Test Plant Lists](#) on page 5-1) are considered to be potentially at risk of attack by the proposed biological control agent of weeds, according to their degree of relatedness to the target weed. The first level of host specificity testing usually concentrates on quick, simple tests to evaluate the response of the proposed organism to the selected plant species. Such preliminary testing is referred to by several different names—first-phase host testing, no-choice testing, starvation testing, or single-plant testing—but usually follows the same general procedure. Published strategies for preliminary testing are further discussed in [Testing Methodology for Biological Control](#) on page F-25.

In general, preliminary testing involves placing immatures of the potential agent on the appropriate plant part/phenological stage of the non-target species, either in a container (such as a petri dish) or enclosed on potted plants where they either feed or eventually die because the host is fundamentally unacceptable. Observations of a similar number of immatures of the potential agents placed on the same part of the target weed serves as a positive control.

At the coarsest resolution of host acceptance behavior, arthropods probe test plants with mouth parts or ovipositors in an effort to discriminate between hosts and non-hosts. In general, such minor probing or tasting are **not** considered to be true feeding, and for all practical purposes can be regarded as nonfeeding.

Arthropods may ingest enough material on certain plants to produce droppings. However, if the life span of the organism will be extended but there is little evidence of continued development, then these accepted but unsuitable species can also be discarded as potential host plants. A final category of host-plant interaction is characterized by those plant species on which the proposed biological control agent of weeds readily feeds, grows, and appears to undergo successful development. As potentially accepted and suitable non-target hosts, risks to these plant species **must** be further evaluated using more refined assessments.

## Multiple-choice Plant Tests

The next level of host specificity testing aims to approximate more natural conditions where arthropods can freely select both the plant species and part of the plant on which to feed, complete development, or oviposit. These tests typically require a reliable supply of live, healthy, potted plants. Plant parts (at minimum, large healthy bouquets of foliage, flowers, seeds, fruit, roots, or stems) can be acceptably used under certain circumstances. Arthropod behavior is often influenced differently by constituent cues produced by intact test plants, in comparison to elicited cues produced as part of test plant damage or wounding responses. Researchers and TAG-BCAW reviewers alike **must** carefully consider the implications of using plant parts rather than whole plants on test results reported in petitions.

Like the no-choice tests, multiple-choice tests may indicate that although development can be successfully completed on non-target species, it may take significantly longer than for the individuals feeding on the target weed (used as a positive control). Arthropods completing development on non-target species may emerge as smaller and less reproductively fit adults than those produced on the target host.

The main purpose of these secondary feeding tests is to identify and eliminate from further testing non-target plant species that are **not** at risk, and focus additional testing on those species that appear to support normal arthropod development.

### Oviposition Testing

Arthropods may complete normal development when confined on nontarget species. This **does not** necessarily mean that nontarget plants would be selected as hosts under (unmanipulated) field conditions. Furthermore, plants **must** first be recognized as hosts before they can be selected by ovipositing females. Oviposition preference is therefore given strong consideration in host specificity testing. Oviposition testing requires larger cages in which mated females can freely move around and choose between non-target and test weed test plants. If oviposition is observed, then the plants are retained under typical field growing conditions to see if eggs will hatch and the larvae will complete their development and produce normal adults.

Like most tests under conducted laboratory conditions, oviposition tests are subject to many limitations. The confined space in the cage or mixing of odors from the enclosed plants can confuse the female into laying eggs on what otherwise would be an unsuitable host. If the foliage of the test plant and the positive control are intertwined, then the female can accidentally deposit eggs on the wrong plant. Some arthropod species use seric chemical or tactile cues to determine if conspecific eggs have already been laid on a plant; if the



number of eggs present exceeds an acceptable threshold, then the female will automatically move on to search for an oviposition site with fewer or **no** eggs.

Because the life span of many arthropod species is relatively short, most females deposit all of their eggs in a fairly restricted oviposition period. If the females **do not** find a suitable host in time, then they may resort to depositing their eggs on any available surface, on what would under normal conditions be considered an unsuitable host. Thus the placement of an egg on a non-target plant may **not** be the result of intentional selection by the female. The importance of using plant material at the appropriate stage of development (phenology) and in a healthy condition for exposure to the proposed biological control agents of weeds is a critical consideration. Results of ovipositing tests **must** be analyzed carefully with a sound understanding and consideration of the biology and ecology of the potential agent.

Oviposition tests are another way to eliminate additional plant species from further testing. These tests can provide useful information on the host specificity of an arthropod species, but they may **not** provide definitive answers to the question of ecological host range.

---

## Field Testing

The most generally-accepted, accurate information on the field host range of a proposed arthropod biological control agent is obtained from tests conducted under natural field conditions. Ideally, nontarget plant species are cultivated alone or in intermixed plots with the target weed in areas where a natural population of the proposed arthropod is known to be present. Arthropods from the surrounding population freely select among the test plants and the target weed for oviposition and subsequent larval development. While this is a much more definitive test, this also has its disadvantages.

Often the foreign country where the field tests are to be conducted will **not** allow North American plants to be introduced and planted due to the risk that they may escape and become weeds. After planting the test plants, the arthropod population in the area may be too low to allow for a realistic assessment. Sometimes this situation can be overcome by enclosing the plants in large cages, collecting the arthropods from the surrounding area (or rearing them artificially in a laboratory), and releasing relatively large numbers in the cage. This remedy may, however, reproduce the cage test biases described above.

Field testing may also include **no-choice** methods (e.g., releasing on critical non-target species patches without the weed present).

## Experimental Design

Due to the wide range of variability in behavior and life cycle demonstrated by each arthropod species, using a standard design for all host testing is unrealistic. Therefore, host testing for each proposed agent requires a slightly different and customized experimental design. The design used should be critically reviewed to determine if rigorous enough experimental standards were used and if adequate quality control was followed.

Each design should be reviewed to determine adequacy and standardization of the following:

- ◆ Quality of host plant
- ◆ Quality of test arthropods
- ◆ Number of plants for each plant species tested
- ◆ Number of plant species used to represent a genus
- ◆ Number of arthropods tested
- ◆ Stage of arthropod used in the test
- ◆ Replication of tests
- ◆ Use of appropriate surrogate plant species in place of rare, threatened, or endangered native plant species
- ◆ Use of actual threatened and endangered species

---

## Conclusion

The general process used in host specificity testing begins with field studies of the arthropod when the arthropod is first found and being considered as a potential biological control agent.

The next step is to screen a large number of test plants to eliminate those species or groups that are **not** at risk.

This is followed by further testing under more natural conditions that eliminate additional plant species and identify those that are possibly at risk of attack by the proposed biological control agent of weeds. At this point in the screening process **only** a few plant species require additional testing. These usually require much more complex and comprehensive tests to determine which could possibly be selected by females as a suitable host and can support natural development of the arthropod.

The results of host testing are easy to evaluate if under several different test arrangements arthropods are found to feed and develop **only** on the target

weed. In this case, there is usually **no** question about host specificity. This situation is usually quite rare; if a realistic selection of test plants is used including many related species, then the arthropod is almost **always** found to have a host range of several species.

In the past, if the other plants in the host specificity tests on which the arthropod fed and developed were weeds or were accidentally-introduced plants of **no** known value, then the release of the insect was usually approved.

However, if the non-target plant attacked is a native species or a desirable agricultural or ornamental plant, then the researcher **must** demonstrate, based on phenology, climatic limits, or geographic range, why the proposed biological control agent of weeds will **not** utilize or at least **not** significantly damage, desirable plant species at a population level.

Therefore, the most important parts of host specificity testing to relate to TAG-BCAW and other reviewers are the petitioner's explanation and interpretation of their results, and how they can be used to extrapolate the potential damage the proposed biological control agent of weeds may cause (should the proposed biological control agent be released) to nontarget plants, especially to threatened and endangered species.

### References

For more information about host specificity testing of arthropods, see the following listed references as well as those listed in [Testing Methodology for Biological Control](#) on page F-25.

Briese, D.T. 2002. The centrifugal phylogenetic method used to select plants for host-specificity testing of weed biological control agents: can and should it be modernised? In: Spafford Jacobs, H.; Briese, D.T. eds. *Improving Selection, Testing, and Evaluation of Weed Biological Control Agents*. Proceedings of the CRC for Australian Weed Management Biological Control of Weeds Symposium and Workshop; 2002 13 Sept.; University of Western Australia, Perth, Western Australia. Adelaide (Australia): CRC for Australian Weed Management, University of Adelaide; 2003. p. 23-33 (CRC Technical Series #7).

Briese, D.T. 2005. Translating host-specificity test results into the real world: the need to harmonise the yin and yang of current testing procedures. *Biological Control* 35: 208-214.

Cullen, J.M. 1988. Current problems in host-specificity screening. In Delfosse, E.S. ed. *Proceedings of the VII International Symposium of the Biological Control of Weeds*; 1988 6-11 March; Istituto Sperimentale per la Patologia Vegetale (MAF); Rome Italy. Melbourne (Australia): DISR/CSIRO; 1990. p. 27-36.

Cullen, J.M. 1992?. Predicting effectiveness: fact and fantasy. In Delfosse, E.S.; Scott, R.R. eds. *Proceedings of the VIII International Symposium on Biological Control of Weeds*; 1992 February 2-7; Lincoln University, Canterbury, New Zealand. Melbourne (Australia). DSIR/CSIRO; 1995? p:103-109.

De Clerck-Floate, R.; Hinz, H.L.; Herd, T.; Julien, M.; Wardill, T.; Cook, C. 2007. Preliminary results of a survey on the role of arthropod rearing in classical weed biological control. In Julien, M.H.; Sforza, R.; Bon, M.C.; Evans, H.C.; Hatcher, P.E.; Hinz, H.L.; Rector, B.G., eds. *Proceed-*

- ings of the XII International Symposium on Biological Control of Weeds; 2007 April 22-27; La Grande Motte, France. Walingford, Oxfordshire (UK): CAB International; 2008. p. 536-542.
- Dunn, P.H. 1976. Shortcomings in classic tests of candidate insects of the biocontrol of weeds. In Freeman, T.E. ed. Proceedings of the IV International Symposium on Biological Control of Weeds; 1976 Aug 30-Sept 2; University of Florida, Gainesville, Florida. Gainesville (Florida): University of Florida Institute of Food and Agricultural Sciences; 1976. p. 51–56.
- Harris, P.; Zwölfer, H. 1968. Screening phytophagous insects for biological control of weeds. *Canadian Entomologist*. 100:295–303
- Harris, P.; McEvoy, P. 1992. The predictability of insect host plant utilization from feeding tests and suggested improvements for screening weed biological control agents. In: Delfosse, E.S.; Scott, R.R. eds. Proceedings of the VIII International Symposium on Biological Control of Weeds; 1992 February 2-7; Lincoln University, Canterbury, New Zealand. Melbourne (Australia): DSIR/CSIRO; 1995. p. 125–131.
- Julien, M.; McFadyen, R.E.C.; Cullen, J. eds. 2012. *Biological Control of Weeds in Australia*. Melbourne (Australia): CSIRO Publishing. 648 p.
- McEvoy P.B. 1996. Host specificity and biological pest control. *BioScience* 46: 401-405.
- McFadyen, R.E.C. 1998 Biological control of weeds. *Annual Review of Entomology* 43: 369-93.
- Schaffner, U. 2001. Host range testing of insects for biological weed control: How can it be better interpreted? *BioScience* 51: 951-959.
- Shepherd, R. C.H. 1990. Problems which arise with host-specificity testing of arthropods. In: Delfosse, E.S., ed. Proceedings of the VII International Symposium on Biological Control of Weeds; 1988 6–11 March; Instituto Sperimentale per la Patologia Vegetale (MAF); Rome, Italy. Melbourne (Australia) DISR./CSIRO; 1990.p. 85–92.
- Spafford-Jacob, H.; Birese, D.T. (eds.) 2003. *Improving the Selection, Testing, and Evaluation of Weed Biological Control Agents*. CRC for Australian Weed Management, Technical Series #7, CRC Weed Management, Adelaide, Australia.
- Van Driesche, R.; Heard, T.; McClay, A.; Reardon, R., technical editors. 1999. Proceedings of Session: Host Specificity Testing of Exotic Arthropod Biological Control Agents—The Biological Basis for Improvement in Safety. X International Symposium on Biological Control of Weeds; 1999 4-14 July; Montana State University, Bozeman, Montana. Morgantown (West Virginia): United States Department of Agriculture, Forest Service, Forest Health Technology Enterprise Team; 2000. 95 p. (FHTET-99-1).
- Van Klinken, R.D.; Edwards, O.R. 2002. Is host specificity of weed biological control agents likely to evolve rapidly following establishment? *Ecology Letters* 5: 590-596.
- Wapshere, A.J. 1974a. Host specificity of phytophagous organisms and the evolutionary centres of plant genera or sub-genera. *Entomophaga* 19: 301–309.
- Wapshere, A.J. 1974b. A strategy for evaluating the safety of organisms for biological weed control. *Annals Applied Biology* 77: 201–211.
- Withers, T.M.; Barton Brown, L.; Stanley, J. (eds.) 1999. *Host Specificity Testing in Australasia: Towards Improved Assays for Biological Control*. Scientific Publications, QLD DNR, Coorparoo, Australia.
- Zwölfer, H.; Harris, P. 1971. Host specificity determination of arthropod for biological control of weeds. *Annual Review of Entomology* 16: 159–178.

# Biological Control of Weeds

## *Host Specificity Testing of Pathogens*

---

### Contents

Introduction	4-4-1
Host Specificity Testing	4-4-1
Protocols and Conditions for Host Specificity Testing	4-4-2
Physiological Conditions	4-4-2
Positive Control	4-4-3
Host Plant Selection	4-4-3
Condition of Test Plants	4-4-3
Growing Conditions	4-4-4
Inoculation Route and Method	4-4-4
Techniques Used for Rating Disease	4-4-4
Disease Symptoms on Nontarget Hosts	4-4-5
Field Trials	4-4-6
Environmental Conditions	4-4-6
Physiological Stage of Test Plants	4-4-7
Controls	4-4-7

---

### Introduction

The *Host Specificity Testing of Pathogens* section of the *Biological Control of Weeds* chapter provides the guidelines for host specificity tests of pathogens that are proposed as biological control agents of weeds. These guidelines are to be read and looked over again by TAG-BCAW members before reviewing and evaluating submitted petitions.

---

### Host Specificity Testing

Host specificity testing of pathogens proposed as biological control agents of weeds (hereafter referred to as pathogens) **must** initially take place under controlled environmental conditions. Frequently these studies are conducted in greenhouses or growth chambers and in quarantine. The use of dew chambers to facilitate fungal infection under controlled conditions is commonplace.

The wide range of problems encountered in raising plants under such conditions might complicate the analysis of test results. A test under conditions that heavily favors disease is the first step to conclude that a negative is a

negative. Then more detailed, quantitative experiments (statistics, etc.) are conducted to clarify what a “non-target effect” actually means. It has been shown that cuticle properties etc., can be different under artificial conditions, leaving plants more susceptible to pathogen attack, and sometimes leading to false positives. Since the cuticle is the primary barrier to infection from foliar pathogens, this may confound results. Therefore, studies conducted in a quarantine facility, with artificial light simulating natural light conditions (daylight, dusk/dawn), would be more approximate of natural conditions.

Many greenhouse coverings exclude ultra-violet light (UV), which when present (as under field conditions) has been shown to be detrimental to many types of pathogens. UV light is known to trigger the production of enzymes in plants that are involved in the immune response to pathogen attack. Hence, field grown plants are often pre-adapted to ward off pathogenic attack.

---

## Protocols and Conditions for Host Specificity Testing

Ascertaining optimum conditions for disease of a target weed is important prior to initiating host range experiments. Although determining optimum conditions for disease may be a lengthy process, it provides the foundation for host range determinations.

Factors that need to be considered include the following:

- ◆ Inoculum application method;
- ◆ Carrier and adjuvants for inoculum application;
- ◆ Concentration of inoculum in the carrier;
- ◆ Total volume of carrier plus inoculum to be applied;
- ◆ Requirement of the pathogen for free water on the leaf surface (dew period);
- ◆ Temperature during dew period and length of dew period; and
- ◆ Temperature of growth chamber after dew period.

---

## Physiological Conditions

The physiological condition of the test plants at the time of pathogen inoculation is an important consideration and should be described in the petition. This is often described by the number of leaves at the time of application. Size of the plant, especially height, is a poor indicator since young plants that are exposed to low light levels might be taller than older plants that were grown under high light conditions. Reproductive status of the plants (phenological stage) may also be useful to note. Part of the plant inoculated, e.g., top or bottom surface of the leaf, is also important to document.

## Positive Control

The petition may **not** necessarily contain the details of how all the preceding experiments were carried out, as long as the petition clearly shows these factors have been considered.

A positive control is one that is reasonably expected to give a positive response. When the researcher uses a positive control in the host specificity tests, the reviewer can be certain that the researcher is striving for evidence that conditions were favorable for disease and that the pathogen was functional.

In the case of a host specificity test, the target weed with a suitable number of replicates **must** be included in all tests. If the pathogen is a compatible agent, then the target weed will exhibit a strong reaction to the pathogen. Susceptibility of biotypes of the target weed needs to be established before host specificity testing is conducted. A representative biotype can then be used as the positive control in subsequent tests.

---

## Host Plant Selection

A strategy based on the Wapshere centrifugal method for selecting plants for host specificity testing is covered under [Test Plant Lists](#) on page 5-1. Another approach is Berner et. al.'s mixed model analysis combining disease ratings and DNA sequences to determine the host range of a pathogen and the use of best linear unbiased prediction (BLUPs) of pathogen host range. Another method takes into account the pathogen's biology (e.g., a rust fungus with primary and alternate hosts in phylogenetically distinct families, host range models based on the known hosts of facultative saprophytes, etc.). Other systems, such as Briese's proposed plant molecular systematics method may also be used.

The identity of the plants **must** be confirmed, the person identifying the plants **must** be named, and the source of propagative material **must** be clearly stated.

---

## Condition of Test Plants

The petitioner should thoroughly describe the conditions under which the test plants were grown. Actively growing plants that are free of arthropods and diseases (i.e., healthy), and that are in a good physiological condition should be used. Where possible, testing leaves of different ages would be advantageous within the same replicate.

The petitioner should describe the phenological stage of test plants (seedlings, vegetative buds, flowers, fruit, seeds). Watering and fertility regimes should be



described, as well as the type and size of containers used. The type of soil used in the pots should be adequately described, since sterile soil can eliminate possible beneficial species that can directly affect susceptibility of plants to diseases such as *Trichoderma* spp. Large plants in small containers often experience nutrient and water stress if application of these factors is **not** frequent enough. Plants that have undergone such stress have activated enzyme systems that can be part of the immune response to pathogenic attack.

---

## Growing Conditions

The growing conditions in the growth facility should be monitored and reported in an appendix to the petition. Critical factors are maximum and minimum air temperatures, duration of these temperatures, and periodic (hourly if possible) reporting of relative humidity, and light spectrum under which the plants were grown. If the petition clearly indicates that these factors were considered, then reporting all of these values in the petition may **not** be essential.

---

## Inoculation Route and Method

The inoculation route (through soil for root pathogens, foliar spray for aerial pathogens, etc.) and inoculation method (use of surfactants, abrasives, wounding, placing inoculated plants under plastic cover, etc.) should be described. The reviewer should be able to assess whether proper route and method of inoculation was used.

---

## Techniques Used for Rating Disease

Another important aspect of host specificity testing is a thorough description of the techniques used for rating disease. Disease incidence and severity should be considered. Incidence is the presence or absence of visual symptoms. Severity involves qualitative and quantitative measures of extent of disease presence. Macroscopic and microscopic evaluation of the infection provides the researcher with a key to use to evaluate any non-target symptoms.

Since there are qualitative factors that **must** be considered, the petition should clearly state what those factors are and how the researcher made the evaluations. Qualitative determinations should be confirmed by some quantitative measure. Macroscopic measurement may be as simple as determining density by counting the number of fungal lesions per leaf and dividing by the size of the leaf. Qualitative terms such as small, medium, and large should be defined in quantitative terms (e.g. 0 to 5 mm, 6 to 10 mm, and >10 mm, respectively). Microscopic measurement which may consist of B&H staining of leaves from initial inoculation to expression enables observation of



a compatible reaction compared to a hypersensitive reaction. Whatever measures are used, the technique should be thoroughly described.

In judging whether the rating system is adequate, the reviewer should determine whether the petition describes the techniques in enough detail that the reviewer could repeat the procedure. The reviewer should then visualize the procedure and make a determination as to whether the techniques employed would yield an accurate picture of the presence and severity of disease. The use of long-accepted techniques, described in a significant body of literature, can help satisfy the reviewer that the techniques are adequate. When well-documented techniques have been used, they should be described in the petition in enough detail to allow those unfamiliar with the literature to visualize what was done. Citations should also be given for those who want to read more.

---

## Disease Symptoms on Nontarget Hosts

In many cases, plant species **other than** the target weed will exhibit some disease symptomatology when challenged with a pathogen under ideal environmental conditions. Those that **do not** can be dropped from further testing.

A phased approach may be used. The first phase is simply plus-and-minus to identify those plant species that are **not** susceptible to get an idea about amounts of disease on potentially susceptible non-targets. The second phase consists of detailed, quantitative if possible, experiments to describe what the disease response means in terms of damage to the non-target.

Another approach is to run side-by-side comparative studies that include a relative of the proposed biological control agent of weeds already in the U.S. or a pathogen on the non-target that is already in the U.S. Infection may occur, but pathogen reproduction may **not**. This is probably acceptable level of risk, depending on the plant species. If the plant so affected is an endangered or threatened species, then determining if the infection causes demonstrable damage to the plant, and stating this finding is desirable. Such damage might be a reduction in growth rate, a reduction in flowering, or a reduction in viability of dispersal organs, such as seeds. However, it should be noted that artificial conditions might favor leaf drop or plants that might **never** flower under greenhouse conditions, and hence assessments obtained under such situations would be dubious.

In another scenario, a small amount of pathogen reproduction may occur, but **no** or little secondary infection might take place, indicating that the pathogen would **not** be able to sustain a population on the non-target species. This may be acceptable risk, but further experimentation is probably prudent in this

situation. Inocula can be collected from this type of infection and used in studies to determine whether the inoculum is viable and infective. If the inoculum is **not** infective, then the risk is probably acceptable.

A measurable secondary infection may occur on nontarget hosts. In this situation, further experimentation is needed. If practical, then field trials (overseas is permissible) can provide insight as to whether these limited types of infection have serious environmental and ecological implications for nontarget plant hosts.

---

## Field Trials

Field trials should be conducted under conditions that favor the growth of the test plants. These conditions should be completely described and should include the following:

- ◆ Fertility and irrigation regimes
- ◆ Location of the test site
- ◆ Planting methods, including between row and within row spacing
- ◆ Soil type
- ◆ Time of year

In the case of exotic pathogens, these trials will be conducted overseas within the native range of the pathogen (ideally in a location climatically similar to that of the intended release area), before approval for release from quarantine.

---

## Environmental Conditions

Environmental conditions during the growth of the test plants, at the time of inoculation, and during the evaluation period should be monitored and reported. The following factors are important to include:

- ◆ Atmospheric humidity
- ◆ Rainfall data
- ◆ Maximum and minimum air temperature
- ◆ Soil temperature
- ◆ Solar radiation (indications of photoperiod and cloud cover)
- ◆ Wind speed

---

## Physiological Stage of Test Plants

The physiological stage of all test plants at the time of inoculation should be indicated.

---

## Controls

As with controlled environment studies, positive controls should be included. The procedure for evaluating disease should be defined as for controlled environment studies.

### References

For more information about host specificity testing of pathogens, refer to the following listed references as well as those listed in [Testing Methodology for Biological Control](#) on page F-25.

- Barton (nee Fröhlich), J. 2004. How good are we at predicting the field host-range of fungal pathogens used for classical biological control of weeds? *Biological Control* 31: 99-122.
- Barton, J. 2011. Predictability of pathogen host range in classical biological control of weeds: an update. *BioControl* DOI 10.1007/s10526-011-9401-7.
- Baudoin, A.B.A.M.; Abad, R.G.; Kok, L.T.; Bruckart, W.L. 1993. Field evaluation of *Puccinia carduorum* for biological control of musk thistle. *Biological Control* 3: 53-60.
- Berner, D.K. 2010. BLUP, a new paradigm in host-range determination. *Biological Control* 53: 143-152.
- Berner, D.K.; Bruckart, W.L. 2005. A decision tree for evaluation of exotic plant pathogens for classical biological control of introduced weeds. *Biological Control* 34: 222-232.
- Berner, D.K.; Bruckart, W.L.; Cavin, C.A.; Michael, J.L. 2009. Mixed model analysis combining disease ratings and DNA sequences to determine host range of *Uromyces salsolae* for biological control of Russian thistle. *Biological Control* 49: 68-76.
- Berner, D.K.; Bruckart, W.L.; Cavin, C.A.; Michael, J.L.; Carter, M.L.; Luster, D.G. 2009. Best linear unbiased prediction of host-range of the facultative parasite *Colletotrichum gloeosporioides* f. sp. *salsolae*, a potential biological control agent of Russian thistle. *Biological Control* 51: 158-168.
- Briese, D.T. 2003. The centrifugal phylogenetic method used to select plants for host-specificity testing of weed biological control agents: can and should it be modernised? In: *Improving the Selection, Testing and Evaluation of Weed Biological Control Agents*. CRC. Technol. Ser. No. 7, pp. 23-33.
- Bruckart, W.L. 1989. Host range determination of *Puccinia jaceae* from yellow starthistle. *Plant Disease* 73: 155-160.
- Bruckart, W.L. 1999. A simple quantitative procedure for inoculation of safflower with teliospores of the rust fungus, *Puccinia carthami*. *Plant Disease* 83: 181-185.
- Bruckart, W.L. 2004. Supplemental risk evaluations and status of *Puccinia carduorum* for biological control of musk thistle. *Biological Control* 32: 348-355.
- Bruckart, W.L. 2006. Supplemental risk evaluations of *Puccinia jaceae* var. *solstitialis* for biological control of yellow starthistle. *Biological Control* 37: 359-366.

- Bruckart, W.L., F. Eskandari, . 2002. Factors affecting germination of *Puccinia jaceae* var. *solstitialis* teliospores from yellow starthistle. *Phytopathology* 92:355-360.
- Bruckart, W.L.; Politis, D.J.; Defago, G.; Rosenthal, S.S.; Supkott, D.M. 1996. Susceptibility of *Carduus*, *Cirsium*, and *Cynara* species artificially inoculated with *Puccinia carduorum* from musk thistle. *Biological Control* 6: 215–221.
- Cook, et al. 1989. Safety of microorganisms intended for pest and plant disease control: a frame work for scientific evaluation. *Biological Control* 7: 333–351.
- Cullen, J.M. 1989. Current problems in host-specificity screening: Proceedings of VII International Symposium on Biological Control of Weeds; Rome, Italy: 27–36.
- Drea, John J., Jr. 1991. The philosophy, procedures, and cost of developing a classical biological control of weeds project. *Natural Areas Journal* 11(3): 143–147.
- Ellison, C.A.; Pereira, J.M.; Thomas, S.E.; Barreto, R.W.; and Evans, H.C. 2006. Studies on the rust *Prospodium tuberculatum*, a new classical biological control agent released against the invasive alien weed *Lantana camara* in Australia. 1. Life-cycle and infection parameters. *Australasian Plant Pathology*. 35: 309-319.
- Evans, H.C. Tomley, A.J. 1994 Studies on the rust, *Maravalia cryptostegiae*, a potential biological control agent of rubber-vine weed, *Cyrtostegia grandiflora* (Asclepiadaceae: Periplocoideae), in Australia, III: Host range. *Mycopathologia* 126: 93-108.
- Fiscus, E.L. 1998. Enzymes give plants UV Protection. *Agricultural Research*. October: p. 11.
- Goeden, R.D. 1983. Critique and revision of Harris' scoring system for selection of insect agents in biological control of weeds. *Protection Ecology* 5: 287–301.
- Harley, K.L.S.; Furno, I.W. 1992. Assessing natural enemies in field studies. In: *Biological control of weeds: a handbook for practitioners and students*. Melbourne, Inkata Press.
- Harris, P.; McEvoy, P. 1995. The predictability of insect host plant utilization from feeding tests and suggested improvement for screening weed biological control agents: Proceedings of the Eighth International Symposium on Biological Control of Weeds: 125–31.
- Hasan, S.; Delfosse, E.S.; Aracil, E.; Lewis, R.C. 1992. Host-specificity of *Uromyces heliotropii*, a fungal agent for the biological control of common heliotrope (*Heliotropium europaeum*) in Australia. *Annals of Applied Biology* 121: 697–705.
- Politis, D.J.; Watson, A.K.; Bruckart, W.L. 1984. Susceptibility of musk thistle and related composites to *Puccinia carduorum*. *Phytopathology* 74: 876–9093.
- Thomas, S.E.; Ellison, C.A.; Tomley, A.J. 2006. Studies on the rust *Prospodium tuberculatum*, a new classical biological control agent released against the invasive alien weed *Lantana camara* in Australia. 2. Host range. *Australasian Plant Pathology* 35: 321-328.

# Format and Evaluation

## *Petitions for Field Release Format*

---

### Contents

Introduction	5-1-1
Format for Petitions for Field Release	5-1-2
Cover Page	5-1-3
Summary	5-1-4
Introduction	5-1-4
Target Weed Information	5-1-5
Biological Control Agent of Weeds Information	5-1-8
Experimental Methodology and Analysis	5-1-11
Results and Discussion	5-1-13
Potential Environmental Impacts	5-1-15
Petitioner's Conclusion	5-1-16

---

### Introduction

The *Petitions for Field Release Format* section of the *Format and Evaluation* chapter contains a guide for petitioners and researchers to follow when preparing a petition; and provides guidelines for TAG-BCAW members to follow when reviewing and evaluating petitions for the release of biological control agents of weeds.

---

## **Format for Petitions for Field Release**

The petitioners and researchers will follow the format below when preparing a petition for biological control agent of weeds for field release. The information requested in this format is believed to best demonstrate the potential risks that might be involved in the proposed biological control agent of weeds release and the long-term ecological consequences of a successful release.

The format for the petition for field release contains the following main sections:

- ◆ [Cover Page](#)
- ◆ [Summary](#)
- ◆ [Introduction](#)
- ◆ [Target Weed Information](#)
- ◆ [Biological Control Agent of Weeds Information](#)
- ◆ [Experimental Methodology and Analysis](#)

## Cover Page

Prepare a cover page for the petition and include the following information on the cover page:

1. Date of the petition and date of mailing.
2. Name of the petitioner, affiliation, and contact information (petitioner's address, email address, telephone number, fax number).
3. Type of petition: Proposed field release of a [*biological control agent*] of a [*target weed(s)*]. Include order, family, genus, species, author, and geographical origin.
  - A. If this petition represents additional information requested by the TAG-BCAW for a previously-submitted petition, then include the TAG-BCAW assigned number of the previous petition.
  - B. If providing additional information requested by TAG-BCAW, then address **only** those sections indicated to be of concern to TAG-BCAW; and highlight the specific sections changed. Include a summary of the changes that were made.
4. List of locations where the studies have been conducted.
5. If part of the study has been conducted in a U.S. quarantine facility or facilities, then list the location of each quarantine facility.
6. List the quarantine facility or facilities the petitioner intends the proposed biological control agent of weeds to pass through prior to initial North American releases.

### NOTICE

Please be aware that pathogens will require a different type of quarantine facility than that used for arthropods.

7. States or Provinces for initial release in the following countries:
  - ❖ Canada
  - ❖ Mexico
  - ❖ United States
8. Name(s) of those person(s), affiliation, and contact information (address, email address, telephone number, fax number) who will be conducting the release(s) and who will be monitoring the release(s) in North America.
9. Confirmation of submission of specimens to each national collection as described on [page 4-2-8](#) under [Reference Collections](#). Please include a copy of the letter sent to each designation collections manager listed in [Table 4-2-1, National Collections for Specimens](#).

## Summary

Include an abstract of the petition, with the following information in the summary:

- ◆ Problem
- ◆ Approach
- ◆ Main findings

---

## Introduction

Include the following information in the petition's introduction:

- ◆ Nature of the Problem
- ◆ Proposed Action

### Nature of the Problem

Give a brief summary (one to two paragraphs) of the problem caused by the weed.

Consider including in the following topics in the summary:

- ◆ History of introduction and/or spread of the target weed
- ◆ Pending issues about the following:
  - ❖ Agent(s)
  - ❖ Location of release
  - ❖ Taxonomy of proposed biological control agent(s) of weeds
  - ❖ Taxonomy of target weed
- ◆ Sectors affected and magnitude of program (e.g., agricultural, natural, rangeland)
- ◆ Target weed's present distribution in North America

### Proposed Action

Provide a statement of the proposed action.

**EXAMPLE** Proposed action: To introduce a *[biological control agent]* from *[a foreign area]* for field release in *[a specific area]* to control *[target weed]* in *[Canada, Mexico, the United States]*.



---

## Target Weed Information

Often detailed information will have been provided in previously-submitted test plant lists or release petitions. This information can be repeated along with additional information in subsequent petitions for field release.

Include the following under the petition's *Target Weed Information*:

- ◆ Taxonomy
- ◆ Description
- ◆ Distribution of the Target Weed
- ◆ Taxonomically-Related Plants
- ◆ Distribution of Taxonomically-Related Plants
- ◆ Life History of the Target Weed
- ◆ Impacts of the Target Weed
- ◆ Management Options

### Taxonomy

Include the following under *Taxonomy*:

1. Full classification, synonymy, and common name; include order, family, genus, species.
2. Cite experts who identified the target weed in North America (name, organizations, locations).
3. List names of experts and publications confirming the presence of the target weed in North America. Include organizations, locations.
4. Problems (and if possible, proposed resolutions) associated with the group's identification or present taxonomy.
5. Origin and location of herbaria containing voucher specimens, and the date of specimen deposit. The voucher specimens referred to here are those used as representatives of the population that occur in the area where the researcher has conducted the studies.

### Description

Provide a general description of the target weed, complete enough that the correct identification could be made by a person encountering the weed in the field.

### **Distribution of the Target Weed**

Describe the distribution of the target weed and use maps, as appropriate. Include the following information:

1. Map of Native range (map).
2. Areas of introduction throughout the world (map), pattern of movement, and apparent limits.
3. Present distribution areas in North America (map).
4. Description of the target weed's areas of potential spread in North America.
5. Genetic and phenotypic variability with respect to geographic distribution.
6. Habitats or ecosystems where this weed is found in North America.

### **Taxonomically-Related Plants**

Include the following:

1. Identify both native and non-native plants that are closely related to the target weed;
2. Emphasize economically and environmentally important species; and
3. Identify crops, ornamentals, and native plants including threatened and endangered species and those with cultural or aesthetic value
  - ❖ If possible, identify how closely these plants are related to the target weed; and
  - ❖ If applicable, include identified surrogates.

### **Distribution of Taxonomically-Related Plants**

Describe the distribution and habitats in North America of the taxonomically-related plants identified under [Taxonomically-Related Plants](#) above.

### **Life History of the Target Weed**

Explain the life history and general biology of the target weed. Discuss the factors that are believed to contribute to the plant's weediness.

### Impacts of the Target Weed

Indicate any and all impacts made by the target weed. Include any potential conflicts. Use the following list as a guide (**not** all areas listed below are applicable to all petitions):

1. Beneficial uses—honey bees, forage, ground cover, fruit, etc.
2. Social and recreational impacts—value as ornamentals or other.
3. Impact on threatened and endangered species.
4. Economic losses, including direct control costs.
5. Health—poisonous, allergenic.
6. Regulatory—noxious weed, restricts trade.
7. Effects on native plant and animal populations.
8. Impact of weed control on nontarget plants.
9. Effects on ecosystem functions and ecological relationships.
10. Other, e.g., aesthetic.

### Management Options

Describe options for managing the target weed.

1. Historical options—what has been done before and its effectiveness.
2. Current options—biological, chemical, cultural, etc., and effectiveness.
3. Potential options—new herbicides or biological control agents used or released in other countries.

---

## Biological Control Agent of Weeds Information

Include the following under *Biological Control Agent Information*:

### NOTICE

If a petition concerning this agent has been previously submitted, then state when and where. Be sure the previously-identified TAG-BCAW concerns are adequately addressed in this submission. Highlight the changes.

- ◆ Taxonomy
- ◆ Geographical Range
- ◆ Known Host Specificity
- ◆ Life History
- ◆ Population of the Biological Control Agent Studied

### Taxonomy

Include the following under *Taxonomy*:

1. Full classification (order, family, genus, species), synonymy, and common names. For pathogens, also include strain, race, or other specific designation (e.g. isolate number, pathovar, etc.).
2. A general description of the proposed biological control agent, including helpful morphology and diagnostic characteristics that could be used to identify the agent in the field.
3. Method for distinguishing the proposed biological control agent in the field and in quarantine (e.g., how the proposed biological control agent will be discriminated from existing related organisms and antagonistic, cryptic, or competing species).
4. Reason for choosing the proposed biological control agent.
5. Taxonomic expert who identified the proposed biological control agent, including the expert's name(s), address, email address, and affiliations (with locations).
6. Problems with identification or with taxonomy. Include citations referencing the issues.
7. For arthropods and pathogens: the origin and locations of voucher specimens, date of specimen deposit, and how the voucher specimens are preserved.
8. For arthropods and pathogens: a description of the methods used to identify life stages.

9. For arthropods and pathogens: If available, DNA analysis or other molecular evaluation.
10. For arthropods and pathogens: Identification/characterization information used to confirm the determination during the evaluation processes and during field colonization efforts overseas.

### Geographical Range

Include the following under *Geographic Range*:

1. Origin of the proposed biological control agent—maps and literature citations describing the native range of the agent.
2. If the proposed biological control agent is being used in other countries, then give the names of countries (ISO country names) of introduction and present range and known site efficacy.
3. Expected, attainable range of the biological control agent outside the area proposed for initial release in North America—based on climatic, environmental, and vegetative preferences of the proposed biological control agent.

### Known Host Specificity

Include the following under *Known Host Specificity*:

1. Literature records indicating other host plants that have been attacked by the proposed biological control agent.
2. Field host-plant collections and observations of the biological control agent in the area of origin, including maps and data.
3. Literature records known host plant specificity of organisms closely related to the biological control agent, **no** matter where the organisms occur.

### Life History

Include the following under *Life History*:

1. Basic biology and life history of the proposed biological control agent (i.e., diapause, resting stages, life cycle, dispersal capability, overwintering, etc. from literature, field observations, and laboratory studies) in enough detail to explain the agent's role in the new environment.
2. Known mortality factors.
3. Extent of damage to or control of the target weed.
4. Extent of damage to or impact on nontarget plants and other organisms.

## **Population of the Biological Control Agent Studied**

Include the following under *Population of Biological Control Agent Studied*:

1. Geographical source(s) (origin) of the biological control agent. If available, include a map and site description. Be as accurate as possible so that the same population can be located if needed.
2. How a pest-free population of the proposed biological control agent was obtained and maintained in quarantine if applicable.
3. Biological control agent studied for the initial release is from the same population used for the studies or the biological control agent for release is identical to those tested (genetic or morphological confirmation).
4. Locations of field studies, lab studies, and quarantine facilities.

---

## Experimental Methodology and Analysis

Include the following under *Experimental Methodology and Analysis* section:

- ◆ Test Plant List
- ◆ Design
- ◆ Positive Controls
- ◆ Rationale for Study Design and Execution

### Test Plant List

Often a new biological control agent will require alteration of a previously-approved test plant list. If this is the case, then so state and identify and explain the rationale and changes. Include the host test plant list, even if **no** changes were made.

#### NOTICE

If an acceptable test plant list was already prepared and reviewed by TAG-BCAW prior to preparing the petition, then so state under the *Test Plant List* heading. Highlight any changes made to the test plant list.

If a test plant list has **not** already been prepared and reviewed by TAG-BCAW prior to preparing the petition, then list the test plant(s) and provide the rationale for selecting the plants.

1. List the species of host plants on which the proposed biological control agent was tested.
2. Explain why the listed plant species were chosen to determine the potential feeding range of the proposed biological control agent.
3. Include considerations given to threatened and endangered plant species and economically important plants.
4. See the required [Test Plant List Format](#) on page 5-1. Follow this format to help ensure that host specificity of the agent is properly circumscribed.
5. See [ESA Compliance](#) on page 6-1 for guidelines to comply with Section 7 and to expedite any review necessary because of protected species.

## Design

Include the following under *Design*:

1. Plant parts and growth stages of all plants tested.
2. Source population of the test plants and target weed used in the test.
3. Number of replicates.
4. Number, stage, and age (arthropods) or phase (pathogens) of individual agents including number of males and females (arthropods), target weeds, and test plants in each replicate. May be synonymous with number of replicates depending on test design (i.e., in **no**-choice tests, the number of individual plants of a species is the number of replicates).
5. Details of experimental setup pertaining to overall environmental conditions and study areas.
6. How data were measured, recorded, and evaluated. Include statistical methods used.

## Positive Controls

Indicate, under *Positive Controls*, how appropriate positive controls were used in all tests. Target is present at every step in the test process.

### NOTICE

The target weed should be challenged with the proposed biological control agent before each testing procedure.

## Rationale for Study Design and Execution

Include under *Rationale for Study Design and Execution*, an explanation of why the test procedures were selected and how they are appropriate for the biology of the agent being tested.



## Results and Discussion

Include the following under the *Results and Discussion* section:

- ◆ Summary of Results
- ◆ Protocol for Releasing the Proposed Biological Control Agent
- ◆ Post-Release Monitoring
- ◆ Benefits and Risks

### Summary of Results

Provide a summary of the environmental impacts of this organism as a biological control agent and any risk associated with its release, including the following:

1. Results in relation to host specificity and environmental impact.
2. Relevant citations of related literature, results of host specificity testing, and field observations.
3. Presenting results in a manner that supports the conclusion (tables, graphs, narratives).

### Protocol for Releasing the Proposed Biological Control Agent

Include the following under *Protocol for Releasing the Proposed Biological Control Agent*:

1. Methods used to ensure pure cultures and correct identification of the proposed biological control agent to be released, including the following:
  - A. For arthropods: species, genus, family, and order.
  - B. For pathogens: strain, race, or other specific designation, e.g. isolate number, pathovar, etc. (Make consistent with above.)
  - C. Names, affiliations, and locations of identifiers. (Make consistent with above.)
  - D. Description of identification methods.
  - E. Problems in identification.
  - F. Date and place of depository containing voucher specimens.
2. General release protocol to ensure the absence of natural enemies and cryptic or sibling species.
3. Specific location of rearing or culturing facility.
4. Intended sites (States or provinces) for initial release. Timing of release. Release methods to be used.

- A. For arthropods: if known, the number to be released.
- B. For pathogens: method of preparing inoculum and inoculum concentration.

### **Post-Release Monitoring**

Include the following explanation of the post-release monitoring plan under *Post-release Monitoring*:

1. When the anticipated initial release of the proposed biological control agent(s) will occur.
2. Groups to best perform monitoring.
3. Monitoring techniques to determine if the proposed biological control agent(s) become established.
4. Monitoring techniques to characterize the spread of the proposed biological control agent and the observed impact (if any) on target and nontarget plants or organisms.

### **Benefits and Risks**

Include the following under *Benefits and Risks*:

1. Provide a comprehensive statement that discloses all relevant known data gaps concerning the proposed biological control agent's and the target weed's biology and ecology.
2. Include the factors that would reasonably influence the probable benefits or possible negative impacts of releasing the biological control agent.
3. Give your perspective, weighing the probable benefits of releasing the agent against the risks associated with the agent.

## Potential Environmental Impacts

Include the following under the *Potential Environmental Impacts* section:

- ◆ Human Impacts
- ◆ Economic Impacts
- ◆ Plant Impacts
- ◆ Nonplant Impacts
- ◆ Abiotic and Edaphic Impacts
- ◆ Methods for Mitigation
- ◆ Outcome of No Action

Discuss and present a clear picture of the long-term ecological consequences that might result from the successful establishment of the proposed biological control agent in the North American environment. This discussion should go beyond the risk associated with attacks on a few closely-related species of plants, as indicated in the host testing results. The discussion should look at the overall potential impact of populations of this proposed biological control agent building up on the weed in a range of habitats.

This information will be considered by APHIS in an environmental assessment (EA), before the Agency considers issuing a permit.

Continue below.

### Human Impacts

Include positive and negative impacts of the proposed biological control agent to humans. Discuss ways to mitigate negative effects.

**EXAMPLE** Health, recreation, aesthetics, nuisance, poison, allergens.

### Economic Impacts

Include a discussion of the potential gains and losses regarding the economic impacts of the proposed biological agent of weeds as follows:

- ◆ Aesthetic impacts
- ◆ Biological impacts
- ◆ Ecological impacts (such as on natural resources, components, structures, and functioning of affected ecosystems)
- ◆ Social impacts (such as cultural)

### Plant Impacts

Describe the value of proposed biological direct and indirect impacts (positive and negative) of the proposed biological control agent on the target plant population against impacts on nontarget plants. Cover the intended effects on the target weed and on nontargets, including potential impacts on agricultural, horticultural, and threatened and endangered plants.

### Abiotic and Edaphic Impacts

Identify the potential abiotic and edaphic impacts of the proposed biological control agent on water, soil, and air resources.

### Nonplant Impacts

Describe the indirect impacts (positive and negative) of the proposed biological control agent's release on organisms (**other than** plants) associated with the target weed (directly or indirectly).

### Methods for Mitigation

Identify the methods (management and other alternatives) to mitigate potentially undesired effects. Include how to control the proposed biological control agent if there is a problem.

### Outcome of No Action

Provide a statement of potential outcomes if the proposed biological control agent is **not** released.

---

## Petitioner's Conclusion

Under the *Petitioner's Conclusion* section, summarize all the results from your study of this proposed biological control agent, its host testing, and your evaluation of the potential environmental impact. Offer your conclusions on the potential risks and benefits regarding the consequences of releasing this proposed biological control agent and its successful establishment in the North American environment throughout the range of its target weed and susceptible nontarget hosts. If available, then include a quantitative risk assessment.

# Format and Evaluation

## *Petitions for Field Release Evaluation*

---

### Contents

Introduction	5-2-1
Evaluation Guidelines—Petitions for Field Release	5-2-1
Agency’s or Organization’s Perspective	5-2-2
Questions or Concerns During Review and Evaluation	5-2-2
Sending Petitions Out for Additional Comments	5-2-2
Petitions for Field Release Checklist	5-2-2
Recording Comments	5-2-3
Reviewer’s Overall Recommendation	5-2-3
Locating Target Weed Information	5-2-3
Locating Biological Control Agent Information	5-2-4
Locating Methods and Approaches Information	5-2-4
Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds	5-2-5
Reviewer’s Overall Recommendation Checklist	5-2-17

---

### Introduction

The *Petitions for Field Release Evaluation* section of the *Format and Evaluation* chapter contains the guidelines for TAG-BCAW members reviewing and evaluating petitions for the release of biological control agents of weeds. Petitioners may use the [Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds](#) to double-check their petitions before submitting for review.

---

### Evaluation Guidelines—Petitions for Field Release

TAG-BCAW members will follow these evaluation guides when reviewing and evaluating petitions for field release of biological control agents of weeds. Review the information in this section before using to the [Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds](#) on page 5-2-5.

Petitioners may use the [Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds](#) on page 5-2-5 to double-check their petitions for field release of a biological control agent prior to submitting the petitions to USDA-APHIS-PPQ.

### **Agency's or Organization's Perspective**

TAG-BCAW members should fully understand their Agency's or organization's current perspective on biological control activities before reviewing the petition. See [Agencies and Organizations' Perspectives](#) on page 2-3-1 for brief summaries.

### **Questions or Concerns During Review and Evaluation**

If a TAG-BCAW member reviewing a petition has questions or concerns that **only** the petitioner could answer or resolve, then the TAG-BCAW member should contact the petitioner directly. The TAG-BCAW member should notify the TAG-BCAW Chair of the question(s) asked and the petitioner's answer(s) so other TAG -BCAW members can be kept informed in case they have similar questions.

### **Sending Petitions Out for Additional Comments**

TAG-BCAW members reviewing petitions should proceed with sending petitions for additional comments as follows:

1. Establish timelines for additional reviews, keeping in mind that the time frame for reviewing and evaluating petitions is 6 weeks. Allow time for any subject matter expert(s) to review and evaluate the petition, as well as for you to synthesize comments and recommend action.
2. Decide whether to send the entire petition or a portion of the petition out for comments.
3. Prepare a request for additional comments cover letter with the following information:
  - A. Specific guidance on which part of the petition you need the subject matter expert(s) (SME) to review.
  - B. Contact information in case the SMEs have questions or concerns. As a TAG-BCAW member, you should remain the individual who directly contacts the petitioner.
  - C. Timeline of when you expect a reply from the SME(s).

### **Petitions for Field Release Checklist**

Use the [Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds](#) (see example on [page 5-2-5](#)) to see how much of this information was addressed by the petitioner and how thoroughly each topic was covered in the petition for release of the proposed biological control agent.

## Recording Comments

Each TAG-BCAW member reviewing a petition will record synthesized comments on a *TAG-BCAW Reviewer's Comment Sheet for Petitions for the Release of Biological Control Agents of Weeds* (see example on [page B-1-2](#)). If the petition was sent for additional review(s), then list the names and subject matter expert areas in *Block E, Summary Comments* (see example in [Figure B-1-2](#) on [page B-3](#)).





## Reviewer's Overall Recommendation

After reviewing all sections of the *Evaluation Guidelines—Petitions for Field Release* and completing the [Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds](#), each TAG-BCAW reviewer will then use the information to develop an overall evaluation and recommendation from their Agency's or organization's viewpoint on the [TAG-BCAW Reviewer's Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds](#).

## Locating Target Weed Information

For additional references about economic botany, host specificity, plant specification systems, plant taxonomy and distribution, protected species, or submitted petitions, see [Table 5-2-1](#).

**Table 5-2-1 Where to Find More Information About Target Weeds**

If you need additional information or research references about:	And:	Then:
Economic Botany		GO to <a href="#">Economic Botany</a> on page <a href="#">F-1-15</a>
Protected Species		GO to <a href="#">Protected Species</a> on page <a href="#">F-1-20</a>
Host Specificity	Arthropods	GO to <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>
	Pathogens	GO to <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>
Plant Classification Systems		GO to <a href="#">Plant Classification System</a> on page <a href="#">E-1-1</a>
Plant Taxonomy and Distribution		GO to <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>
Submitted Petitions	Current list	GO to <a href="#">TAG-BCAW site</a>
	Historical list	GO to <a href="#">TAG-BCAW site</a>

## Locating Biological Control Agent Information

For additional research references about biological control agents, identification and characterization of agents, or host specificity, see [Table 5-2-2](#).

**Table 5-2-2 Locating Biological Control Agent Information**

If you need information about:	And:	Then:
Biological control agents	—————→	GO to <a href="#">Biological Control Agents</a> on page <a href="#">F-1-5</a>
Identification and characterization of agents	—————→	GO to <a href="#">Identification and Characterization of Proposed Biological Control Agents of Weeds</a> on page <a href="#">4-2-1</a> and <a href="#">References</a> on page <a href="#">F-1-1</a>
Host specificity	Arthropods	GO to <a href="#">Host Specificity Testing of Arthropods</a> on page <a href="#">4-3-1</a> and <a href="#">References</a> on page <a href="#">F-1-1</a>
	Pathogens	GO to <a href="#">Host Specificity Testing of Pathogens</a> on page <a href="#">4-4-1</a> and <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>

## Locating Methods and Approaches Information

For additional information about methods and approaches most commonly used by researchers, then see [Table 5-2-3](#).

**Table 5-2-3 Locating Biological Control Agent Information**

If you need:	And for:	And:	Then:
Review basic information or research additional references	Host specificity	Arthropods	GO to <a href="#">Host Specificity Testing</a> on page <a href="#">4-3-2</a> and <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>
		Pathogens	GO to <a href="#">Host Specificity Testing of Pathogens</a> on page <a href="#">4-4-1</a> and <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>
Testing methodology for biological control operations	—————→	—————→	GO to <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>



## Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds

Use the evaluation checklist in [Table 5-2-4](#) to record how much of this information was addressed by the petitioner and how thoroughly each topic was covered in the petition for field release of the proposed biological control agent of weeds.

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation**

Petition Section		Is the following information included?	Yes	No
<b>Cover page</b> (see <a href="#">page 5-1-3</a> )		Date of petition and date of mailing		
		Petitioner's complete name, affiliation, and contact information (address, email address, telephone number, fax number)		
		Type of Petition: Proposed biological control agent is clearly identified (order, family, genus, species, author, geographical origin); and target weed is clearly identified (order, family, genus, species, author, geographical origin)		
		If petition is in response to additional information requested by TAG-BCAW, then original petition's TAG-BCAW assigned number		
		If providing additional specific information requested by TAG-BCAW, then <b>only</b> the requested sections have been addressed and changed and highlighted; includes a summary of the changes made		
		Locations where the studies have been conducted		
		If part of the study has been conducted in a U.S. quarantine facility or facilities, then the location of each quarantine facility		
		<div style="border: 2px solid black; padding: 5px;"> <div style="background-color: #0056b3; color: white; padding: 2px;"><b>NOTICE</b></div> <p>Pathogens will require a different type of quarantine facility than used for arthropod agents.</p> </div>		
		Quarantine facility or facilities petitioner intends the proposed biological control agent(s) to pass through prior to initial North American releases		
		States or Provinces for initial release in Canada, Mexico, and/or United States		
	Person's name, affiliation, and contact information (address, email address, telephone number, fax number) who will be conducting the release and monitoring in North America			

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Summary</b>		Abstract of the petition with a summary of the problem, approach, and main findings		
<b>Introduction</b> (see <a href="#">page 5-1-4</a> )	<b>Nature of the Problem and Proposed Action</b> (see <a href="#">page 5-1-4</a> )	TAG-BCAW Reviewers: The introduction of the petition should provide a quick overview of the nature of the problem and the petitioner’s proposed action		
		<ol style="list-style-type: none"> <li>1. Read the petition introduction</li> <li>2. Determine if you will need additional reviews by subject matter experts within your Agency or organization in order to formulate an informative recommendation from your Agency’s or organization’s perspective</li> <li>3. If you determine that you need additional reviews, then see <a href="#">Sending Petitions Out for Additional Comments</a> on page 5-2-2</li> <li>4. If you <b>do not</b> need additional reviews, then review the petition following the guidelines in this checklist</li> <li>5. Use a <a href="#">TAG-BCAW Reviewer’s Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds</a> (example on <a href="#">page B-1-2</a>)</li> </ol>		
		There are issues about the taxonomy for either the target weed or the biological control agent		
		You need a subject matter expert to validate the taxonomic information—entomologist, biologist, botanist		
		There are issues about the proposed biological control agent		
		There are issues about the location of the release		

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Target Weed Information</b> (see <a href="#">page 5-1-5</a> )		<i>TAG-BCAW Reviewers:</i> If you need to review basic information or research additional references, then see <a href="#">Table 5-2-1</a> on page 5-2-3		
		This weed is identified as having been previously targeted as either a previously submitted petition for field release of a biological control agent of weeds or a previously-submitted test plant list		
		If a petition for field release of a biological control agent or a test plant list has been previously submitted, then this includes a discussion of how the weed information compares with previous discussions and the changes are highlighted		
	<b>Taxonomy</b> (see <a href="#">page 5-1-5</a> )	Full classification (order, family, genus, species); synonymy, and common name		
		Expert who identified the target weed in North America is cited (name, organization(s), and locations)		
		Experts who confirmed the target weed's presence in North America are listed (organizations and locations)		
		Problems associated with the group's identification or present taxonomy and proposed resolutions (if any)		
		Origin and location of the herbaria containing voucher specimens and date of deposit		
	<b>Description</b> (see <a href="#">page 5-1-5</a> )	General physical description of the target weed is complete enough that correct identification could be made by a person encountering the target weed in the field		
	<b>Distribution of the Target Weed</b> (see <a href="#">page 5-1-6</a> )	<i>TAG-BCAW Reviewers:</i> Distribution of Target Weed section should provide you with a sense of where the target weed will spread in North America		
Adequate description and map of native range				
Adequate description and map of the areas of introduction throughout the world, pattern of movement, and apparent limits				
Adequate description and map of the target weed's present distribution in North America				
Adequate description and map of target weed's areas of potential spread in North America				
Adequate description of genetic and phenotypic variability with respect geographic distribution				
Adequate description of the habitats or ecosystems where the weed is found in North America				

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Target Weed Information</b> (see <a href="#">page 5-1-5</a> )	<b>Taxonomically Related Plants</b> (see <a href="#">page 5-1-6</a> )	Both native and non-native plants that are closely related to the target weed		
		Emphasizes economically and environmentally important species		
		Crops, ornamentals, and native plants including endangered or threatened species that are closely related to the target weed. If applicable, includes identified surrogates		
		Adequate description of how closely these plants are related to the target weed		
	<b>Distribution of Taxonomically Related Plants</b> (see <a href="#">page 5-1-6</a> )	Adequate description of the distribution and habitats in North America of those taxonomically related plants identified under <a href="#">Taxonomically Related Plants</a> above		
		If information is lacking, then add comments on the <a href="#">TAG-BCAW Reviewer’s Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds</a> on page B-1-2. Otherwise, see <a href="#">Reviewer’s Overall Recommendation Checklist</a> on page 5-2-17		
	<b>Life History of the Target Weed</b> (see <a href="#">page 5-1-6</a> )	Adequate explanation of life history of the target weed		
		Adequate explanation of general biology of the target weed		
		Discussion of factors that are believed to contribute to the plants weediness		

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Target Weed Information</b> (continued) (see <a href="#">page 5-1-5</a> )	<b>Impacts of the Target Weed</b> (see <a href="#">page 5-1-7</a> )	Information about the impacts and potential conflicts made by the target weed is helpful in evaluating the release of the proposed biological control agent of weeds. Use the following areas of impact as a guide when reviewing a petition. <b>Not</b> all areas listed below are applicable to all petitions		
		Beneficial uses: honey bees, forage, ground cover, fruit, etc.		
		Social and recreational impacts: valued as an ornamental or other		
		Threatened or endangered species		
		Economic losses, including direct control costs		
		Health: poisonous, allergenic		
		Regulatory: noxious weed, restricts trade		
		Native plant populations and animal populations		
		Weed control on nontarget plants		
		Ecosystem functions and ecological relationships		
	Other impacts (e.g., aesthetics)			
	<b>Management Options</b> (see <a href="#">page 5-1-7</a> )	Historical options for managing the target weed; what has been done before and its effectiveness		
		Current options: biological, chemical, cultural, and effectiveness		
Potential options: new herbicides, biological control agents used or released in other countries				
		<b>NOTICE</b>		
		Petitioner may <b>not</b> have information on new chemicals developed.		

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Biological Control Agent Information</b> (see <a href="#">page 5-1-8</a> )		<i>If you need to review basic information or research additional references about biological control agents, then see <a href="#">Biological Control Agent of Weeds Information</a> on page 5-1-8</i>		
		Petition concerning this agent has been previously submitted (when and where)		
		If a petition concerning this agent has been previously submitted, then the previously-identified TAG-BCAW concerns have been adequately addressed in this latest submission and are highlighted		
	<b>Taxonomy</b> (see <a href="#">page 5-1-8</a> )	Full classification: ◆ For Arthropods (order, family, genus, species) synonymy, and common name ◆ For Pathogens, also strain, race or other specific designation (isolate number, pathovar, etc.)		
		General description of the proposed biological control agent of weeds, including morphology, and diagnostic characteristics that could be used to identify the proposed biological control agent in the field		
		Reason for choosing this proposed biological control agent		
		Taxonomic expert who identified the proposed biological control agent, expert's information (name, address, email address, and affiliations with locations)		
		Problems with identification or with taxonomy, including citations and referencing issues		
		<i>Look for reference of an authoritative identification</i> Arthropods and pathogens: look for the origin and locations of voucher specimens, date of specimen deposit, how the voucher specimens are preserved		
		More detail is needed because a complex or problem taxonomic group is involved		
		Arthropods and pathogens: description of methods used to identify life stages		
		Arthropods and pathogens: If available, then DNA analysis or other molecular evaluation is included (useful when differentiation among close taxonomic groups is difficult using standard morphometric techniques)		
		Arthropods and pathogens: Voucher methods are appropriate to the taxa or level of science involved		
		Arthropods and pathogens: location of the voucher specimens (recognized taxonomic institutions are the best sources for information about voucher specimens)		

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Biological Control Agent Information</b> (continued) (see <a href="#">page 5-1-8</a> )	<b>Taxonomy</b> (continued) (see <a href="#">page 5-1-8</a> )	Arthropods and pathogens: Identification/ characterization information was used to confirm the determination during the evaluation processes (additional collections, long-term rearing, etc.) and during field colonization efforts overseas  Method for distinguishing the proposed biological control agent in the field and in quarantine (e.g., how the agent will be discriminated from existing, related organisms from antagonistic, cryptic, or competing species)		
	<b>Geographical Range</b> (see <a href="#">page 5-1-9</a> )	This section should provide you with a good understanding of the potential range of the biological control agent		
		Adequate description of the native range of the biological control agent (maps and literature citations)		
		Adequate description of the names of the countries (see list of <a href="#">ISO country codes</a> ; select “Country codes” followed by “Search”) where the proposed biological control agent has been introduced, its present range, and its known efficacy are shown		
		Potential spread of the biological control agent outside the area proposed for the initial release in North America based on climatic, environmental, and vegetative parameters is shown		
	<b>Known Host Specificity (range)</b> (see <a href="#">page 5-1-9</a> )	This section should give you a good sense of other plants the agent utilizes in its native range		
		Literature records indicating other host plants the proposed biological control agent is known to attack		
		Field host-plant collections and observations of the biological control agent in the area of origin including maps and data		
		Literature records for known host plants of organisms closely related to the biological control agent (regardless of where the organism occurs)		

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Biological Control Agent Information</b> (continued) (see <a href="#">page 5-1-8</a> )	<b>Life History</b> (see <a href="#">page 5-1-9</a> )	Information provided is specific to the proposed biological control agent (the importance of a biological control agent's life history will vary)		
		Basic biology and life history of the proposed biological control agent are provided in enough detail to explain the proposed biological control agent's role in the new environment		
		Known mortality factors		
		Extent of damage to or control of the target weed		
		Extent of damage to or impact on the nontarget plants and other organisms		
		<b>Population of the Agent Studied</b> (see <a href="#">page 5-1-11</a> )	This section should provide adequate information to ensure compatibility in the conditions between the locations of the study site and of the potential release site	
	Geographic source(s) (origin) of the biological control agent population is adequately described so the same population can be located if needed. A map and a description are included if available			
	How a pest-free population of the proposed biological control agent was obtained and maintained in quarantine if applicable			
	Biological control agent studied for the initial release is from the same population used for the studies or the biological control agent for release is identical to those tested (genetic or morphological confirmation)			
	Locations of field studies, lab studies, and quarantine facilities			



**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section	Is the following information included?	Yes	No	
<b>Experimental Methodology and Analysis</b> (see <a href="#">page 5-1-11</a> )	The description (method and data) should be sufficient for someone who is qualified to repeat the experiment. If you need more information about methods and approaches commonly used by research or to review basic information or research additional references, then see <a href="#">Table 5-2-3</a> on page 5-2-4			
	<b>Test Plant List</b> (see <a href="#">page 5-1-11</a> )	If an acceptable test plant list was already prepared and reviewed by TAG-BCAW prior to preparing the petition, then so states		
		Identifies and explains the rationale and changes to the test plant list; changes are highlighted		
		Includes the host test plant list, even if <b>no</b> changes were made		
		Lists the species of host plants on which the proposed biological control agent was tested		
		Explains why the listed host plant species were chosen to determine the proposed biological control agent's potential feeding range		
		Considerations are given to threatened and endangered species and economically important plants		
	<b>Design</b> (see <a href="#">page 5-1-12</a> )	Petitioner provides the following information about the design of the tests		
		Part and growth stage of the plants tested		
		Source population of test plants and target weeds used in the tests		
		Number of replicates		
		Number and stage (arthropods) or phase (pathogens) of individual proposed biological control agents (number of males and number of females (arthropods), target weeds, and test plants in each replicate; these numbers may be synonymous depending on the test design (i.e., in no-choice tests, the number of individual plants of a species is the number of replicates)		
		Details of the experimental setup pertaining to overall environmental conditions and study areas		
		Explanation of how the data were measured, recorded, and evaluated and statistical methods used		
<b>Positive Controls</b> (see <a href="#">page 5-1-12</a> )	How appropriate positive controls were used in all tests (positive control is where the target is present at every step in the test process)			
<b>Rationale for Study Design and Execution</b> (see <a href="#">page 5-1-12</a> )	Explanation of why the test procedures were selected and how they are appropriate for the biology of the proposed biological control agent being tested			

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Results and Discussion</b> (see <a href="#">page 5-1-13</a> )	<b>Summary of Results</b> (see <a href="#">page 5-1-13</a> )	Results discussed in relation to host specificity and environmental impact		
		Method of presentation is appropriate to show the results		
		TAG-BCAW Reviewer: If the method of presentation is <b>not</b> appropriate to show the results, then contact the petitioner directly to ask for the results in another way that would help you better understand the results		
		Interpretation and significance of the results may be different between arthropods and pathogens; as a TAG-BCAW reviewer, you reached the same conclusion as the petitioner through interpretation of the data		
	<b>Protocol for Releasing the Proposed Biological Control Agent</b> (see <a href="#">page 5-1-13</a> )	Consider your Agency's or organization's concerns when evaluating this section of the petition		
		Methods used for ensuring pure cultures and correct identification of the proposed biological control agent to be released		
		Arthropods: species, genus, family, and order		
		Pathogens: strain, race, or other specific designation, e.g. isolate number, pathovar, etc. (consistent with above)		
		Names, affiliations, and locations of identifiers (consistent with above)		
		Description of identification methods		
		Problems in identification		
		Date and place of depository containing voucher specimens		
		General release protocol to ensure the absence of natural enemies and cryptic or sibling species		
		Specific location of rearing or culturing facility		
Intended sites (States or provinces) for initial release				
Timing of release				
Release methods to be used				
Arthropods: if known, the number to be released				
Pathogens: method of preparing inoculum and inoculum concentration				

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section		Is the following information included?	Yes	No
<b>Results and Discussion</b> (continued) (see <a href="#">page 5-1-13</a> )	<b>Post Release Monitoring</b> (see <a href="#">page 5-1-14</a> )	Plan for post-release monitoring		
		Monitoring plan adequately describes how the spread and impact of the proposed biological control agent on the target weed and nontarget plants will be determined		
		Monitoring plan adequately describes monitoring techniques to be used to determine if the biological control agent becomes established		
		Monitoring plan adequately describes groups to best perform monitoring		
	<b>Benefits and Risks</b> (see <a href="#">page 5-1-14</a> )	Comprehensive statement of potential benefits and risks associated with the agent		
		Comprehensive statement discloses all relevant data gaps concerning the proposed biological control agent's and the target weed's biology and ecology that might reasonably influence the probable benefits or possible negative impacts of releasing the agent. See <a href="#">Risk Assessment</a> on page <a href="#">F-1-21</a> for additional information		

**Table 5-2-4 Checklist for Field Release of Biological Control Agent of Weeds Evaluation (continued)**

Petition Section	Is the following information included?	Yes	No	
<b>Potential Environmental Impacts</b>	The petitioner should present a clear picture of the long-term ecological consequences that might result from the successful establishment of the proposed biological control agent in the North American environment. The discussion should go beyond the risk associated with attacks on a few closely-related species of plants, as indicated in the host specificity testing results. The discussion should look at the overall potential impact of populations of the proposed biological control agent building up on the weed in a large variety of different habitats			
	<b>Human Impacts</b> (see <a href="#">page 5-1-15</a> )	Positive and negative impacts of the proposed biological control agent of weeds on humans considered  Ways to mitigate any negative effects of the proposed biological control agent of weeds on humans		
	<b>Economic Impacts</b> (see <a href="#">page 5-1-15</a> )	Gains and losses regarding the economic impacts: aesthetic impacts, biological impacts, ecological impacts (such as on natural resources, components, structures, and functioning of affected ecosystems), and social impacts (such as cultural) of the proposed biological control agent of weeds		
	<b>Plant Impacts</b> (see <a href="#">page 5-1-16</a> )	Value of the proposed biological control agent of weeds introduction on target populations against impacts on nontarget plants, including potential impacts (positive and negative) on agricultural, horticultural, and threatened and endangered plants		
	<b>Nonplant impacts</b> (see <a href="#">page 5-1-16</a> )	Positive and negative impacts (if any) of the proposed biological agent's release to nonplant organisms associated with the target weed (directly or indirectly)		
	<b>Abiotic and Edaphic Effects</b> (see <a href="#">page 5-1-16</a> )	Potential effects of the proposed biological control agent of weeds on water, soil, and air resources		
	<b>Methods for Mitigation</b> (see <a href="#">page 5-1-16</a> )	Mitigative methods are identified for controlling the proposed biological control agent of weeds should a potential problem occur		
	<b>Outcome of No Action</b> (see <a href="#">page 5-1-16</a> )	Statement of potential outcomes if the proposed biological control agent of weeds is <b>not</b> released		
<b>Petitioner's Conclusion</b>	Petitioner offers conclusions about the potential risks and benefits of releasing the proposed biological control agent of weeds			
	Discussion includes the probability of successful establishment of the proposed biological control agent in the environment throughout the range of its target weed and susceptible nontarget hosts			
	Quantitative risk assessment (a quantitative risk assessment is <b>not</b> necessary)			

## Reviewer's Overall Recommendation Checklist

After you have finished reviewing the petition and completing the [Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds](#), provide an overall assessment of the following items in [Table 5-2-5](#).

Record your overall recommendation on the [TAG-BCAW Reviewer's Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds](#).

**Table 5-2-5 TAG-BCAW Reviewer's Overall Recommendation Checklist—Petitions for Field Release of Biological Control Agents of Weeds**

TAG-BCAW Reviewer's Recommendation	Yes	No
Completeness and comprehensiveness in completing the sections of the petition		
<b>Thoroughness in addressing your Agency's or organization's concerns:</b>		
Were your concerns met		
If your concerns were <b>not</b> met, then provide a summary of your Agency's or organization's concerns and the reasoning behind them		
Confidence level in the testing conducted and the information presented about the use of the proposed biological control agent in the environment		
If you have concerns regarding the risk of releasing this agent in North America, then provide specific comments		
Recommendation of your Agency or Organization		
Provide the name, affiliation, telephone, fax, and email numbers of the reviewer		
Provide the name(s) of other subject matter experts who provided comments		
Provide the name(s) of other subject matter expert(s)		
Sign and date the Comment Sheet		
Send the completed <i>TAG-BCAW Reviewer's Comment Sheet for Petitions for the Release of Biological Control Agents of Weeds</i> to the TAG-BCAW Chair through the TAG-BCAW Executive Secretary	Mr. Gregg B. Goodman TAG-BCAW Executive Secretary <b>USDA-APHIS-PPQ</b> 4700 River Road, Unit 133, Office 4C-01.48 Riverdale, MD 20737 Email: <a href="mailto:gregg.b.goodman@aphis.usda.gov">gregg.b.goodman@aphis.usda.gov</a> Fax: 301-734-5269	



# Format and Evaluation

## *Test Plant List Format*

---

### Contents

Introduction	5-3-1
Test Plant Lists	5-3-1
Format for Test Plant Lists	5-3-2
Cover Page	5-3-2
Introduction to the Test Plant List	5-3-3
Target Weed Information	5-3-3
Test Plant List	5-3-6
Summary Table	5-3-11
Perspective of Risk	5-3-11
Strategy for Developing a Test Plant List	5-3-12

---

### Introduction

The *Test Plant List Format* section of the *Format and Evaluation* chapter provides the format for test plant lists for biological control agents of weeds in North America.

---

### Test Plant Lists

Test plant lists are developed by researchers and petitioners for determining the host specificity of biological control agents of weeds in North America. The test plant list is done as a benefit to the researcher and as a tool to get input from Federal Agencies, whether there is benefit in doing research. This **does not** preclude the Federal Agencies from taking a look at the list included in the petitions when they come in.

A test plant list should be submitted early in the study (before the petition is submitted), when a researcher or petitioner is proposing to target a new weed for biological control.

When the petitioner submits a petition for field release of a proposed biological control agent of weeds, the petition will include an updated test plant list. The updated test plant list contains those plants actually tested based on the TAG-BCAW's evaluation of the original test plant list. (Submitting a test plant list early will allow researchers to understand concerns that various Federal Agencies have in relation to the target and nontarget plants or other organisms.

Preliminary information about a target weed and a proposed biological control agent of weeds may be incomplete at this point in the research. The proposed test plant list may comprise the majority of the available information.

---

## Format for Test Plant Lists

The format for the test plant list is as follows:

- ◆ Cover Page
- ◆ Introduction to the Test Plant List
- ◆ Target Weed Information
- ◆ Test Plant List
- ◆ Summary Table
- ◆ Perspective of Risk

### Cover Page

Prepare a cover page for the test plant list with the following information. This information provides the TAG-BCAW with a contact point for questions and with references for tracking.

Include the following information on the cover page:

1. Date test plant list is being submitted to TAG-BCAW.
2. Name of the researcher or petitioner submitting test plant list, (address, email address, telephone number, and fax number), affiliation and a contact point within North America (address, email address, telephone number, and fax number).
3. Name of the target weed, including its order, family, genus, species, and common name(s).
4. State if the weed is targeted for biological control the first time.
5. If this is **not** the first time the weed is targeted, then include the previous petition number assigned by TAG-BCAW.
6. If any proposed biological control agent(s) of weeds, then identify the agent(s).
7. Location.



---

## Introduction to the Test Plant List

Include the following information in the Introduction to the *Test Plant List* section:

- ◆ Nature of the Problem
- ◆ Proposed Action

### Nature of the Problem

Give a brief summary (one to two paragraphs) of the problems caused by the target weed. Items to consider follow:

1. History of introduction and spread of the target weed.
2. Weed's present distribution in North America.
3. Sectors affected and magnitude of program (e.g., agricultural, natural, rangeland).
4. Consensus that the weed is suitable target for control.

### Proposed Action

Include the following statement:

This host plant list is to notify TAG-BCAW of our intent to begin a biological control program for the control of *[weed]*. *[Weed]* has been declared a noxious weed in *[list States]* and is considered a target for biological control. Your comments on the accuracy, appropriateness, and thoroughness of this list is appreciated.”

## Target Weed Information

Include the following in the *Target Weed Information* section:

- ◆ Taxonomy
- ◆ Description
- ◆ Distribution of the Target Weed
- ◆ Taxonomically Related Plants
- ◆ Distribution of Taxonomically Related Plants
- ◆ Life History
- ◆ Impacts
- ◆ Alternative Management Options
- ◆ Known Host Range of Proposed Biological Control Agent

### **Taxonomy**

Include the target weed taxonomy information, as follows:

1. Full classification (including order, family, genus, species), synonymy, and common name.
2. The taxonomist who identified the target weed, including name(s), organization(s), and location(s).
3. Problems in identification or present taxonomy.
4. Origin and locations of herbaria containing the voucher specimens used as representative of the population that occurs in the area where the researcher has conducted the studies and the date of deposit.

### **Description**

Provide a general physical description of the target weed, complete enough so identification could be made by a person encountering the target weed in the field.

### **Distribution of the Target Weed**

Describe the distribution of the target weed using maps, as appropriate. Include the following information:

1. Native range (map).
2. Areas of introduction throughout the world, pattern of movement, and apparent limits (map).
3. Present distribution in North America (map).
4. Range areas of potential spread in North America (map).
5. Genetic variability.
6. Habitats or ecosystems where this weed is found in North America.

### **Taxonomically Related Plants**

Include the following:

1. Identify the economically and environmentally important plants that are closely related to the target weed. These are crops, ornamentals, and native plants.
2. Identify threatened and endangered species closely related to the target weed.
3. If possible, identify how closely related economic, environmentally important species, and threatened and endangered species are to the target weed.

**Distribution of Taxonomically Related Plants**

Describe the distribution and habitats in North America of the closely-related (taxonomically related) plants and identified under [Taxonomically Related Plants](#)).

**Life History**

Explain the life history and general biology of the target weed. Discuss the factors that are believed to contribute to the plant's invasiveness.

**Impacts**

Indicate any and all impacts of the target weed. Use the following list as a guide and indicate the impacts (**not** all areas listed below are applicable to all weeds).

1. Beneficial uses: honey bees, forage, ground cover, fruit, etc.
2. Cultural, social and recreation uses: value as ornamentals.
3. Threatened and endangered species.
4. Economic losses, including direct control costs.
5. Health: poisonous, allergens.
6. Regulatory: noxious weed, restricts trade.
7. Effects on native plant populations.
8. Weed control on nontarget plants.
9. Ecosystem functions and ecological relationships.
10. Other impacts (e.g., aesthetic).

**Alternative Management Options**

Describe alternative options for managing the target weed and include the following:

1. Historical options: what has been done before.
2. Current options: biological, chemical, cultural.
3. Potential options: new herbicides or biological control agents used or released in other countries.

### **Known Host Range of Proposed Biological Control Agent**

If known, then provide the following information about the proposed biological control agent:

1. Name(s) and taxonomic classifications (order, family, genus, species).
2. Literature records indicating other plants that have been attacked.
3. Field collections and observations, including maps and data.
4. Literature on host range of closely-related species to the proposed biological control agent.

If the host range of the proposed biological control agent of weeds is unknown, then indicate “the unknown.”

### **Test Plant List**

See [ESA Section 7 Interagency Cooperation \(50 CFR Part 402\) Overview](#) on page 6-2 for guidelines to comply and to expedite any review necessary because of protected species. Consult the U.S. Fish and Wildlife Service very early in the project.

Include the following under the *Test Plant List* section:

- ◆ **Categories of Test Plants**
  - ❖ **Category 1:** Genetic types of the target weed species (varieties, races, forms, genotypes, apomicts, etc.) found in North America and the native range.
  - ❖ **Category 2:** Species in the same genus as the target weed, divided by subgenera (if applicable)
  - ❖ **Category 3:** Species in other genera in the same family as the target weed, divided by subgenera (if applicable)
  - ❖ **Category 4:** Threatened and endangered species in the same family as the target weed divided by subfamily, genus, and subgenus
  - ❖ **Category 5:** Species in other families in the same order that have some phylogenetic, morphological, or biochemical similarities to the target weed
  - ❖ **Category 6:** Species in other orders that have some morphological or biochemical similarities to the target weed
  - ❖ **Category 7:** Any plant on which the proposed biological control agent or its close relatives have been previously found or recorded to feed and/or reproduce

### Categories of Test Plants

The usual strategy for developing a test plant list for evaluating biological control agents of weeds in North America is based on A. J. Wapshere (1974), *A Strategy for Evaluating the Safety of Organisms for Biological Weed Control*, published in *Annals of Applied Biology*. The strategy is based on the phylogenetic approach, where closely-related species are theorized to be at greater risk of attack than are distantly-related species.

*Category 1: Genetic types of the target weed species (varieties, races, forms, genotypes, apomicts, etc.) found in North America and the native range.*

Include the following information:

- ◆ Genetic variability of the target weed;
- ◆ Justification of genetic types selected for testing from those identified;
- ◆ Inferences about effects on untested types based on selected types (if any);
- ◆ If many types exist, then justification of the number selected for testing;
- ◆ References; and
- ◆ If references are **not** available, then provide an explanation.

*Category 2: Species in the same genus as the target weed, divided by subgenera (if applicable).*

Include the following information:

- ◆ Detailed information on what is known about the phylogenetic relationship of the target weed to other species in the same genus;
- ◆ Information on which species are most likely to be found in the same range and habitat as the target weed;
- ◆ Information on any economically, environmentally, and culturally sensitive important plant species of North America found in the genus;
- ◆ Justification of species selected for testing from those identified in the same genus as the target weed;
- ◆ Discussion of how the selected species may or may **not** enable the petitioner to make inferences about effects on untested species;
- ◆ If there are many species in the genus, then justification of the number selected for testing;
- ◆ References; and
- ◆ If references are **not** available, then provide an explanation.

*Category 3: Species in other genera in the same family as the target weed, divided by subgenera (if applicable).*

Include the following information:

- ◆ Detailed information on what is known about the phylogenetic relationship of the target weed to other groups (i.e., subfamilies, genera, species in the same family);
- ◆ Information on which groups (i.e., subfamilies, genera, species) are most likely to be found in the same range and habitat as the target weed;
- ◆ Information on any economically, environmentally, and culturally sensitive important species found in the family in North America;
- ◆ Justification of the species selected for testing from those identified as *Category 3*;
- ◆ Discussion of how the selected species may or may **not** enable the petitioner to make inferences about effects on untested species;
- ◆ If there are many genera in the family, then justification of the number selected for testing;
- ◆ References; and
- ◆ If references are **not** available, then provide an explanation.

*Category 4: Threatened and endangered species in the same family as the target weed divided by subfamily, genus, and subgenus.*

Include the following information in a table format:

- ◆ All known species in the same **family** as the target weed that are listed as threatened or endangered species or candidates, including the full scientific name (order, family, subfamily, genus, subgenus, species), status, and range in North America (see references for [Protected Species](#) on page [F-20](#));
- ◆ All species in the same **genus** as the target weed that are listed by the U.S. Fish and Wildlife Service as threatened or endangered or candidates (see [Section 7 Consultations](#) on page [6-1](#) and [Protected Species](#) on page [F-20](#));
- ◆ All species within the same **genus** as the target weed that are identified as sensitive on designated lists, such as Natural Heritage Program lists, Canadian Province lists, or Mexican State lists (The Conservation Directory is a good resource to identify organizations that maintain such lists. See [Protected Species](#) on page [F-20](#));
- ◆ Which groups (threatened or endangered species) are likely to be found in the same range and habitat as the target weed;
- ◆ Justification of the species selected for testing from those identified as *Category 4* or select surrogates, since seeds/plants of threatened and

endangered species can be hard to obtain and may further threaten populations;

- ◆ Justification of the surrogates based on phylogenetic, morphological, and/or biochemical similarities;
- ◆ Discussion of how the selected species may or may **not** enable the petitioner to make inferences about effects on untested species;
- ◆ If many threatened and endangered species exist, then justify the number selected for testing; and
- ◆ References of threatened and endangered lists consulted.

*Category 5: Species in other families in the same order that have some phylogenetic, morphological, or biochemical similarities to the target weed.*

Include the following information:

- ◆ Outline of families in the same order as the target weed;
- ◆ Classification using Angiosperm Phylogeny Classification System and including any additional families listed;
- ◆ If using an alternate system of classification, then justification of its use;
- ◆ Which families in this order are most closely related to the target weed's family according to phylogenetic studies;
- ◆ Discussion of any morphological or biochemical relationship the target weed or its family has with any group (i.e., family, genus, species) in this order;
- ◆ Which groups (i.e., family, genus, species) are likely to be found in the same range and habitat as the target weed;
- ◆ Any economically, environmentally, culturally sensitive, important species in these groups (i.e. family, genus, species) found in North America;
- ◆ Justification of the species selected for testing from those identified as being in *Category 5*;
- ◆ Discussion of how the selected species may or may **not** enable the petitioner to make inferences about effects on untested species;
- ◆ If there are many groups (i.e., species, genus, family), then an explanation of the number selected for testing;
- ◆ References; and
- ◆ If references are **not** available, then provide an explanation.

*Category 6: Species in other orders that have some morphological or biochemical similarities to the target weed.*

Include the following information:

- ◆ Discussion of any morphological or biochemical relationship the target weed has with any group (i.e., family, genus, species) in other orders;
- ◆ Which groups (i.e., family, genus, species) are likely to be found in the same range and habitat as the target weed;
- ◆ Any economically, environmentally, and culturally sensitive, important plant species in these groups (i.e., family, genus, species) found in North America;
- ◆ Justification of the species selected for testing from those identified as being in *Category 6*;
- ◆ Discussion of how the selected species may or may **not** enable the petitioner to make inferences about effects on untested species;
- ◆ If there are many groups (i.e., family, genus, species), then explain the number selected for testing;
- ◆ References; and
- ◆ If references are **not** available, then provide an explanation.

*Category 7: Any plant on which the proposed biological control agent or its close relatives have been previously found or recorded to feed and/or reproduce.*

Include the following information:

- ◆ Details, including the full scientific name and range of any plant on which the proposed biological control agent or its close relatives (within the same genus) have been previously found or recorded to feed and/or reproduce;
- ◆ Proposal to test all species on which the proposed biological agent of weeds has been found or recorded to feed and/or reproduce;
- ◆ Species selected for testing from the plants on which any close relatives have been recorded to feed;
- ◆ Justification of the species selected from those identified;
- ◆ Discussion of how the selected species may or may **not** enable the petitioner to make inferences about effects on untested groups; and
- ◆ If many species have been fed/reproduced on by the agents' close relatives, then provide an explanation of the number for testing.



## Summary Table

Summarize in a table format, all the species being considered for testing. Include pertinent literature references that are helpful in describing rationale. List the species in phylogenetic order (i.e., distantly- to closely-related to the target weed).

### NOTICE

In actual host testing of proposed biological control agents of weeds, **not** all of these plants are expected to be used. Depending on the feeding behavior or life cycle of the agent, the researcher would select representative features similar to those on which the agent normally feeds.

**EXAMPLE** If the agent's larva overwinter in a large tap root, then annual plants or those with fibrous roots could be disregarded.

## Perspective of Risk

Include the following under *Perspective of Risk*:

1. Briefly discuss how the selected species should enable inferences to be made about risk of attack on untested species.
2. Indicate the limits of allowable attack within the phylogenetic hierarchy of the test plant list, and why.
3. Include pertinent literature references that are helpful in describing rationale.

## Strategy for Developing a Test Plant List

The following steps are **only** a suggested strategy for developing a test plant list. Follow this strategy along with the Angiosperm Phylogeny Plant Classification System and the references listed in [Table 5-3-1](#) on page [5-3-13](#).

1. Outline the families in the same order as the target weed using the Angiosperm Phylogeny Group classification.
2. Examine the placement of the target weed family in the Angiosperm Phylogeny Group classification.
3. If the Angiosperm Phylogeny Group places a new family in the order of the target weed, then consider that family when developing a list of *Category 5* plants.
4. If **only** one of the systematists places a new family in the order of the target weed, then consider that family when developing a list of *Category 6* plants. Look for economically or environmentally important species in the new families that occur in the target areas.
5. The references listed in [Table 5-3-1](#) may be useful in developing a list of test plants for each category. See full [References](#) on page [F-1](#).

**Table 5-3-1 References for Developing a Test Plant List**

Helpful References	Categories
The Angiosperm Phylogeny Group Classification	5, 6
Andersen Horticultural Library's Sources List of Plants and Seeds. Issacson, R.T. (1993 or later edition)	1, 2
Hortus Third, A Concise Dictionary of Plants Cultivated in the United States and Canada. Bailey, L.H. and Bailey, E.Z. (1976)	1, 2, 3, 5
A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland. Kartesz, J.T. (1994)	1, 2, 3, 5
Dictionary of Economic Plants. Uphof, J.C.Th. (1968)	2, 3, 5
Families and Genera of Spermatophytes Recognized by the Agricultural Research Service. ARS Technical Bulletin 1796	3, 5
Germplasm Resources Information Network (GRIN) database at <a href="https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomyquery.aspx">https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomyquery.aspx</a> USDA Agriculture Research Service (ARS)	1, 2, 3
Gray's Manual of Botany. Fernald, M.L. (1970)	2, 3, 5
Manual of Cultivated Plants. Bailey, L.H (1951)	2, 3, 5
Mabberley's Plant Book. Mabberley, D.J. (2008)	2, 3, 5, 6
North American floras that include the release areas	2, 3, 5, 6
The PLANTS Database at <a href="http://plants.usda.gov/">http://plants.usda.gov/</a> . USDA NCRS. National Plant Data Center, Baton Rouge, LA 70874-4490 USA	2, 3
U.S. Fish and Wildlife Services Endangered Species Program Site at <a href="http://www.fws.gov/endangered/">http://www.fws.gov/endangered/</a> . List of endangered and threatened species, including candidate species	2, 3, 4



# Format and Evaluation

## *Test Plant List Evaluation*

---

### Contents

Introduction	5-4-1
Evaluation Guidelines for Test Plant Lists	5-4-1
Questions or Concerns During Review or Evaluation	5-4-2
Sending Test Plant Lists Out for Additional Comments	5-4-3
Recording Comments	5-4-3
Reviewer's Overall Recommendation	5-4-3
Target Weed Information	5-4-3
Evaluation Checklist for Test Plant Lists	5-4-5
Reviewer's Recommendation Checklist for Test Host Plant Lists	5-4-17

---

### Introduction

The *Test Plant List Evaluation* section of the *Format and Evaluation* chapter provides the evaluation guidelines and the evaluation checklist for TAG-BCAW members to use when evaluating a proposed test plant list. Petitioners may use the checklist to double-check their test plant lists prior to submitting to USDA-APHIS-PPQ.

---

### Evaluation Guidelines for Test Plant Lists

When a test plant list is submitted by a petitioner or researcher, TAG-BCAW members **must** subject the test plant list to as critical a review as would be used for evaluating a petition. Starting a biological control program with the best possible test plant list will ultimately save valuable time, money, and patience for government and public supporters of biological control.

The test plant list you will be reviewing may be either of the following:

- ◆ Test plant list for TAG-BCAW evaluation submitted early in the study when a researcher or petitioner is proposing a new weed for biological control, but prior to actually submitting the petition for biological control agent of weeds (TAG-BCAW may make recommendations of plants to be used in the testing process); or
- ◆ Test plant list (of plants actually used in the testing process) to TAG-BCAW submitted for the first time along with the petition for biological control agent of weeds.

If the **original** test plant list is being submitted early in the study but prior to actually submitting the petition for biological control agent of weeds, then the TAG-BCAW reviewer will make recommendations on the target weed choice and comments on the proposed test plant list for host specificity testing. This provides the researcher or potential petitioner the opportunity to conduct additional research and field tests of test plants and to adjust the test plant list prior to submitting the actual petition for field release of biological control agent of weeds.

If the **original** test plant list is being submitted for the first time along with the petition for field release of biological control agent, then the petitioner **must** give complete information on the target weed and the biological control agent.

If the updated test plant list is being submitted along with the petition for biological control agent, then the petitioner **must** give complete information on the target weed and biological control agent and have made improvements to the list of plants that have actually been tested based on TAG-BCAW's evaluation of the **original** test plant list. Thoroughly justifying additions to the test plant list is important.

The evaluation guidelines provide a strategy for TAG-BCAW members to evaluate test plant lists to determine host specificity. The strategy is based on A. J. Wapshere (1974), *A Strategy for Evaluating the Safety of Organisms for Biological Weed Control*, published in *Annals of Applied Biology*. The strategy is based on the phylogenetic approach, where closely-related species are theorized to be at greater risk of attack than are distantly-related species.

### Questions or Concerns During Review or Evaluation

If a TAG-BCAW member reviewing a test plant list has questions or concerns that **only** the petitioner or researcher could answer or resolve, then contact the petitioner or researcher directly. The TAG-BCAW member will notify the TAG-BCAW Chair about the question(s) and the petitioner's or researcher's answers, so the other TAG-BCAW reviewers can be kept informed (as they may have similar questions).

## **Sending Test Plant Lists Out for Additional Comments**

TAG-BCAW members reviewing test plant lists should formulate sending test plant lists out for additional comments as follows:

1. Establish timelines for additional review of the test plant list, keeping in mind that the time frame for reviewing and evaluating petitions is 6 weeks. Allow time for any subject matter expert(s) to review and evaluate the petition, as well as time to synthesize comments and recommend action.
2. Decide whether to send the entire test plant list or a portion of the test plant list out for comments.
3. Prepare a request for additional comments cover letter with the following information:
  - A. Specific guidance on which part of the test plant list you need the subject matter expert(s) (SME) to review.
  - B. Your contact information in case the SMEs have questions or concerns. As a TAG-BCAW member, you should remain the individual who directly contacts the petitioner or researcher.
  - C. Timeline of when you expect a reply from the SME(s).

## **Recording Comments**

Each TAG-BCAW member reviewing a test plant list will use the [TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds](#) (see example on page [page B-1-5](#)), to record any comments.

If you sent the test plant list for additional review(s), then list the names of the subject matter expert(s) in *Block D, Comments/List of Additional Subject Matter Experts* of the comment sheet (see [page B-1-5](#)).

## **Reviewer's Overall Recommendation**

After reviewing all sections of and completing the [Evaluation Checklist for Test Plant Lists](#) on page [5-4-5](#) and the [Reviewer's Recommendation Checklist for Test Host Plant Lists](#) on page [5-4-17](#), the TAG-BCAW reviewer will then use the information to develop an overall evaluation and recommendation and record on the [page B-1-6](#).

## **Target Weed Information**

To locate references about economic botany, protected species, host specificity, plant classification system, plant taxonomy and distribution, and previously-submitted petitions, see [Table 5-4-1](#).

**Table 5-4-1 Where to Find More Target Weed Information**

If you need to review basic information or research additional references about:	And is for:	Then:
Economic Botany	→	GO to <a href="#">Economic Botany</a> on page <a href="#">F-1-15</a>
Protected Species	→	GO to <a href="#">Protected Species</a> on page <a href="#">F-1-20</a>
Host Specificity	Arthropods	GO to <a href="#">Host Specificity Testing of Arthropods</a> on page <a href="#">4-3-1</a> and <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>
	Pathogens	GO to <a href="#">Host Specificity Testing of Pathogens</a> on page <a href="#">4-4-1</a> and <a href="#">Testing Methodology for Biological Control</a> on page <a href="#">F-1-25</a>
Plant Classification System	→	GO to <a href="#">Plant Classification System</a> on page <a href="#">E-1-1</a>
Plant Taxonomy and Distribution	→	GO to <a href="#">Plant Taxonomy and Distribution</a> on page <a href="#">F-1-16</a>
Submitted Petitions	Current List	GO to <a href="#">TAG-BCAW Web site</a>
	Historical List	GO to <a href="#">TAG-BCAW Web site</a>



## Evaluation Checklist for Test Plant Lists

Continue below and use the checklist in [Table 5-4-2](#) to evaluate the test plant lists.

**Table 5-4-2 Evaluation Checklist for Test Plant Lists**

Test Plant List Section	Is the following information included:	Yes	No
<b>Cover Page</b> (see <a href="#">page 5-3-2</a> )	Date test plant list submitted to TAG-BCAW by the petitioner		
	Name of the researcher or petitioner submitting test plant list, affiliation, and contact point in North America (address, email address, telephone number, fax number)		
	Target weed (order, family, genus, species), common names		
	First time this weed is targeted for biocontrol		
	If this is <b>not</b> the first time this weed is targeted for biological control, then lists the previous petition number assigned by TAG-BCAW		
	Proposed biological control agent(s) of weeds (if any)		
	Location		

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section	Is the following information included:	Yes	No
<p><b>Introduction to the Test Plant List</b> (see <a href="#">page 5-3-3</a>)</p>	<p>TAG-BCAW Reviewers: The introduction of the test plant list should provide a quick overview of the nature of the problem and the researcher's proposed action. After reviewing, determine if you will need a subject matter expert within your Agency or organization to review the test plant list in order to formulate an informative recommendation from your Agency's or organization's perspective.</p> <p>If you need additional reviews, then follow the guidelines for <a href="#">Sending Test Plant Lists Out for Additional Comments</a> on page 5-4-3. To locate more information about target weeds, see <a href="#">Target Weed Information</a> on page 5-4-3</p>		
<p><b>Nature of the Problem</b> (see <a href="#">page 5-3-3</a>)</p>	<p>Brief summary of the nature of the problem (History of introduction and spread of the target weed)</p> <p>Weed's present distribution in North America</p> <p>Sectors affected and magnitude of program (e.g., agricultural, natural, rangeland)</p> <p>Consensus that the weed is suitable target for control</p>		
<p><b>Proposed Action</b> (see <a href="#">page 5-3-3</a>)</p>	<p>Brief summary of researcher's proposed action:</p> <p>This host plant list is to notify TAG-BCAW of our intent to begin a biological control program for the control of <i>[weed]</i>. <i>[Weed]</i> has been declared a noxious weed in <i>[list States]</i> and is considered a target for biological control. Your comments on the accuracy, appropriateness, and thoroughness of this list is appreciated</p>		

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section	Is the following information included:	Yes	No
<b>Target Weed Information</b> (see <a href="#">page 5-3-3</a> )	Test plant list for TAG-BCAW evaluation was submitted early in the study when a researcher or petitioner is proposing a new weed for biological control, but prior to actually submitting the petition for biological control agent of weeds (TAG-BCAW may make recommendations of plants to be used in the testing process)		
	Test plant list (of plants actually used in the testing process) to TAG-BCAW submitted for the first time along with the petition for biological control agent of weeds		
	This weed has been previously targeted and there is either a previously-submitted petition or a previously-submitted test plant list		
	If there is a previously submitted test plant list or petition, then the current discussion of weed and test plant information is compared with previous discussions		
<b>Taxonomy</b> (see <a href="#">page 5-3-4</a> )	Full classification (order, family, genus, species), synonymy, and common name		
	Classification goes far enough to address any concerns		
	There is evidence that the identification needs to go beyond species		
	Qualified taxonomist (person's name, organization(s), location(s) who identified the target weed		
	Problem(s) exists with the identification or present taxonomy (if any)		
	Origin locations of herbaria containing the voucher specimen(s) used as representative of the population occurring in the area where the researcher conducted the studies, and date of specimen deposit		

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section		Is the following information included:	Yes	No
<b>Target Weed Information</b> (see page 5-3-3)	<b>Description</b> (see page 5-3-4)	General physical description of the target weed is complete enough that identification could be made by a person encountering the weed in the field		
	<b>Distribution of the Target Weed</b> (see page 5-3-4)	TAG-BCAW Reviewers: This section should provide you with a sense of where the target weed is distributed and will potentially spread in North America		
		Adequate description of the native range (map)		
		Adequate description of the areas of introduction throughout the world, pattern of movement, and apparent limits (map)		
		Adequate description of the present distribution in North America (map)		
		Adequate description of the range areas of potential spread in North America (map)		
		Adequate description of the genetic variability		
	<b>Taxonomically Related Plants</b> (see page 5-3-4)	Adequate description of the habitats or ecosystems where the weed is found in North America		
		Identification of economically and environmentally important plants that are closely related to the target weed		
		Identification of threatened and endangered plants that are closely related to the target weed		
	<b>Distribution of Taxonomically Related Plants</b> (see page 5-3-5)	If possible, a description of how closely related economic, environmentally important species, and threatened and endangered species are to the target weed		
		Adequate description of the distribution and habitats in North America of plants taxonomically related to the target weed and identified under <i>Taxonomically Related Plants</i>		
	<b>Life History</b> (see page 5-3-5)	Explanation of the life history of the target weed		
		Explanation of the general biology of the target weed		
		Discussion of factors that contribute to the plant's invasiveness		

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section		Is the following information included:	Yes	No
<b>Target Weed Information</b> (see <a href="#">page 5-3-3</a> )	<b>Impacts</b> (see <a href="#">page 5-3-5</a> )	Information about the impacts made by target weeds are helpful in preparing a risk assessment and evaluating the risk associated with releasing the proposed biological control agent(s) of weeds. Use the following areas of impact as a guide. <b>Not</b> all areas will apply to all plants selected for testing		
		Beneficial uses—honey bees, forage, ground cover, fruits, etc.		
		Cultural, social and recreational uses—valued as an ornamental		
		Threatened and endangered species		
		Economic losses, including direct control costs		
		Health—poisonous, allergens		
		Regulatory—noxious weed, restricts trade		
		Native plant communities		
		Weed control on nontarget plants		
		Ecosystem functions and ecological relationships		
Other impacts (e.g., aesthetic)				

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section		Is the following information included:	Yes	No	
<b>Target Weed Information</b> (continued) (see <a href="#">page 5-3-3</a> )	<b>Alternative Management Options</b> (see <a href="#">page 5-3-5</a> )	Historical options—what has been done before			
		Current options—biological, chemical, cultural			
		Potential options—new herbicides, biological control agents used or released in other countries (researchers may <b>not</b> have information on new chemicals being developed)			
	<b>Known Host Range of Proposed Biological Control Agent</b> (see <a href="#">page 5-3-6</a> )	<div style="background-color: #0056b3; color: white; padding: 2px;"><b>NOTICE</b></div> The petitioner may <b>not</b> have addressed this topic since a test plant list is submitted early in the research.			
		Name and taxonomic classification (order, family, genus, species) of the proposed biological control agent			
		Literature records indicating other plants that have been attacked			
		Field collections and observations, including maps and data			
		Literature on host range of closely-related species to the proposed biological control agent of weeds			
		If host range of the proposed biological control agent is unknown, then stated			

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section	Is the following information included:	Yes	No
<p><b>Test Plant List</b> (page 5-3-6)</p>	<p>Review the test plant list to see if the following categories of plants are covered. The species chosen for each category are representative species to be tested</p>		
<p>Category 1: Genetic types of the target weed species (varieties, races, forms, genotypes, apomicts, etc.) found in North America (see page 5-3-7)</p>	<p>Genetic variability of the target weed</p>		
	<p>Justification of the genetic types selected for testing from those identified</p>		
	<p>Discussion of how selected types may or may <b>not</b> enable the petitioner to make inferences about effects on untested types</p>		
	<p>Justification of the number selected for testing In the event that many types exist</p>		
	<p>References</p>		
	<p>If references are <b>not</b> included, then an explanation</p>		
<p>Category 2: Species in the same genus as the target weed, divided by subgenera (if applicable) (see page 5-3-7)</p>	<p>What is known about the phylogenetic relationship of the target weed to other species in the same genus</p>		
	<p>Which species are most likely to be found in the same range and habitat as the target weed</p>		
	<p>Economically, environmentally, and culturally sensitive important plant species of North America found in the genus</p>		
	<p>Justification of species selected for testing from those identified in the same genus as the target weed</p>		
	<p>Discussion of how the selected species may or may <b>not</b> enable the petitioner to make inferences about effects on untested species</p>		
	<p>If there are many species in the genus, then justification of the number selected for testing</p>		
	<p>References</p>		
	<p>If references are <b>not</b> included, then an explanation</p>		

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section		Is the following information included:	Yes	No
<b>Test Plant List</b> (page 5-3-6)	Category 3: Species in other genera in the same family as the target weed, divided by subgenera (if applicable) (see page 5-3-8)	Details on what is known about the phylogenetic relationship of the target weed to other groups (i.e., subfamilies, genera, species) in the same family		
		Which groups (i.e., subfamilies, genera, species) are most likely to be found in the same range and habitat as the target weed		
		Economically, environmentally, and culturally sensitive important species found in the family in North America		
		Justification of the species selected for testing from those identified as <i>Category 3</i>		
		Discussion of how the selected species may or may <b>not</b> enable the petitioner to make inferences about effects on untested species		
		If there are many genera in the family, then the number selected for testing is justified		
		References		
		If references are <b>not</b> included, then an explanation		



**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section		Is the following information included:	Yes	No
<b>Test Plant List (continued)</b> (see <a href="#">page 5-3-6</a> )	Category 4: Threatened and endangered species in the same family as the target weed divided by subfamily, genus, and subgenus (see <a href="#">page 5-3-8</a> )	Category 4's information is in a table format		
		All known threatened or endangered species or candidates in the same family as the target weed, and includes the full scientific name (order, family, subfamily, genus, subgenus, and species), status, and range within North America (see references for <a href="#">Protected Species</a> on page F-1-20)		
		All species in the same genus as the target weed that are listed by the U.S. Fish and Wildlife Service as threatened or endangered or candidates (see <a href="#">Section 7 Consultations</a> on page 6-1-1 and <a href="#">Protected Species</a> on page F-1-20)		
		All species within the same genus as the target weed that are identified as sensitive on designated lists, such as Natural Heritage Program lists, Canadian Province lists, or Mexican State lists ( <i>The Conservation Directory</i> is a good resource to identify organizations that maintain such lists. See <a href="#">Protected Species</a> on page F-1-20)		
		Which groups (threatened or endangered species) are likely to be found in the same range and habitat as the target weed		
		Justification of the species selected for testing from those identified as <i>Category 4</i> or select surrogates (since seeds/plants of threatened and endangered species can be hard to obtain and may further threaten populations)		
		Justification of the surrogates based on phylogenetic, morphological, and/or biochemical similarities		
		Discussion of how the selected species may or may <b>not</b> enable the petitioner to make inferences about effects on untested species		
		In the event that many threatened and endangered species exist, then a justification of the number selected for testing		
References of threatened and endangered lists consulted				

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section		Is the following information included:	Yes	No
<p><b>Test Plant List</b> (continued) (see <a href="#">page 5-3-6</a>)</p> <p>Category 5: Species in other families in the same order which have some phylogenetic, morphological, or biochemical similarities to the target weed (see <a href="#">page 5-3-9</a>)</p>	Outline of families in the same order as the target weed			
	Angiosperm Phylogeny Classification System used (see <a href="#">Plant Classification System</a> on page <a href="#">E-1-1</a> ) and included any additional families listed			
	If an alternate system of classification used, then a justification of the selection			
	Which families in this order are most closely related to the target weed's family according to phylogenetic studies			
	Discussion of any morphological or biochemical relationship the target weed or its family has with any group (i.e., family, genus, species) in this order			
	Which groups (i.e., family, genus, species) are likely to be found in the same range and habitat as the target weed			
	Any economically, environmentally, and culturally sensitive important species in these groups (i.e. family, genus, species) found in North America			
	Justification of the species selected for testing from those identified as being in <i>Category 5</i>			
	Discussion of how the selected species may or may <b>not</b> enable the petitioner to make inferences about effects on untested species			
	If there are many groups (i.e., species, genus, family), then an explanation of the number selected for testing			
	References			
If references are <b>not</b> included, then an explanation				

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section		Is the following information included:	Yes	No
<p><b>Test Plant List</b> (continued) (see <a href="#">page 5-3-6</a>)</p>	<p>Category 6: Species in other orders which have some morphological or biochemical similarities to the target weed  (see <a href="#">page 5-3-10</a>)</p>	Discussion of any morphological or biochemical relationship the target weed has with any group (i.e. family, genus, species) in other orders		
		Which groups (i.e., family, genus, species) are likely to be found in the same range and habitat as the target weed		
		Any economically, environmentally, culturally sensitive important species in these groups (i.e., family, genus, species) found in North America		
		Justification of the species selected for testing from those identified as being in <i>Category 6</i>		
		Discussion of how the selected species may or may <b>not</b> enable the petitioner to make inferences about effects on untested species		
		If there are many groups (i.e., family, genus, species), then an explanation of the number selected for testing		
		References		
	If references are <b>not</b> included, then an explanation			
	<p>Category 7: Any plant on which the biological control agent or its close relatives (within the same genus) have been previously found or recorded to feed and/or reproduce  (see <a href="#">page 5-3-10</a>)</p>	Details, including the full scientific name and range of any plant on which the biological control agent or its close relatives (within the same genus) have been previously found or recorded to feed and/or reproduce		
		Proposal to test all species on which the proposed biological agent of weeds has been found or recorded to feed and/or reproduce		
		Species selected for testing from the plants on which any close relatives have been recorded to feed		
		Justification of the species selected from those identified		
		Discussion of how the selected species may or may <b>not</b> enable the petitioner to make inferences about effects on untested groups		
		If many species have been fed/reproduced on by the agents' close relatives, then explained the number for testing		

**Table 5-4-2 Evaluation Checklist for Test Plant Lists (continued)**

Test Plant List Section	Is the following information included:	Yes	No
<b>Summary Table</b> (see <a href="#">page 5-3-11</a> )	Table format summary of all the species recommended for testing in phylogenetic order (i.e., closely-to-distantly related to the target weed)		
<b>Perspective of Risk</b> (see <a href="#">page 5-3-11</a> )	Discussion of how the selected species should enable a TAG-BCAW Reviewer to make inferences about risk of attack on untested species		
	Estimation of the limits of allowable attack within the phylogenetic hierarchy of the test plant list and explanation why		
	References		
	If references are <b>not</b> included, then an explanation		

## Reviewer's Recommendation Checklist for Test Host Plant Lists

Use the results of the [Evaluation Checklist for Test Plant Lists](#) on page 5-4-5 and complete [Table 5-4-2](#).

Read the information in [Table 5-4-3](#) below, and follow the recommendation checklist. Use the [TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds](#) to record whether the information in the Test Plant List is complete and comprehensive or if information is lacking completeness. If information is lacking, then record your comment(s) about any concern(s) on the comments sheet, too..

**Table 5-4-3 Checklist for Reviewer's Completion of Test Host Plant Lists**

Reviewer's Recommendation	Yes	No
Review the completed evaluation Checklist for Test Plant Lists and comments made on the <i>TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Biological Control Agents of Weeds</i> , as well as those comments made by other subject matter experts		
Recommend the test plant list either be approved or be returned for revision and additions. Provide reasons for revision and additions		
Provide the name, affiliation, telephone, fax, and email numbers of the reviewer		
Include the names of other subject matter experts who provided comments		
Include your TAG-BCAW member identification number and date the Comment Sheet is submitted to TAG-BCAW Executive Secretary		
Send the completed <i>TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Biological Control Agents of Weeds</i> to the TAG-BCAW Chair through the TAG-BCAW Executive Secretary at the following address:  Mr. Gregg B. Goodman, TAG-BCAW Executive Secretary <b>USDA-APHIS-PPQ</b> 4700 River Road, Unit 133, Office 4C-01.48 Riverdale, MD 20737  Email: <a href="mailto:gregg.b.goodman@aphis.usda.gov">gregg.b.goodman@aphis.usda.gov</a>		



# ESA Compliance

## Section 7 Consultations

---

### Contents

[Introduction](#) **6-1-1**

[Endangered Species Act \(ESA\)](#) **6-1-1**

[ESA Section 7 Interagency Cooperation \(50 CFR Part 402\) Overview](#)  
**6-1-2**

[Technical Advisory Group for Biological Control Agents of Weeds \(TAG-BCAW\) and Section 7 Consultations](#) **6-1-6**

---

### Introduction

The *Section 7 Consultations* section of the *ESA Compliance* chapter provides an overview of Section 7 of the Endangered Species Act, U.S. Fish and Wildlife's role with Section 7 in the review of biological control agents; and TAG-BCAW and Section 7 Consultations.

---

### Endangered Species Act (ESA)

The Endangered Species Act (ESA) is one of the nation's most comprehensive and important environmental laws. Developing and implementing this landmark environmental legislation has placed the United States in the forefront of nations protecting imperiled species and habitat conservation. The ESA has served as a model for other nations to develop natural resource conservation programs and legislation. The core purpose of the ESA is to conserve endangered and threatened species and the ecosystems on which these species depend.

Section 7 of the ESA addresses interagency cooperation. TAG-BCAW reviewers and petitioners are encouraged to read the ESA and its implementing regulations under Title 50 of the *Code of Federal Regulations*, especially the implementing regulations for Section 7 in 50 CFR Part 402.

Continue to [ESA Section 7 Interagency Cooperation \(50 CFR Part 402\) Overview](#).

## ESA Section 7 Interagency Cooperation (50 CFR Part 402) Overview

### NOTICE

This overview is **not** all encompassing concerning the intricacies of the ESA Section 7 process, but provides a general blueprint to help petitioners facilitate necessary compliance and expedite ESA reviews. It is **not** intended to constitute, nor does it convey, legal advice.

This overview covers what the Endangered Species Act (ESA) requires of Federal Agencies (in this case APHIS), and how petitioners can participate in the ESA Section 7 process. This includes the U.S. Fish and Wildlife Service's (FWS) role on TAG-BCAW. FWS can assist in minimizing the risk to natural ecosystems associated with the use of biological control agents.

Section 7(a)(1) requires all Federal Agencies, in consultation with and with the assistance of the Secretary of the Interior, to utilize their authorities to carry out programs for the conservation of endangered and threatened species.

Section 7(a)(2, 4) requires all Federal Agencies, in consultation with and with the assistance of the Secretary of the Interior, to ensure that any action they fund, authorize, or carry out is **not** likely to jeopardize the continued existence of any listed species, or destroy or adversely modify designated critical habitat <sup>1</sup>.

The scope of Federal actions and authorizations that fall under Section 7 is broad and includes, but is **not** limited to, the granting of any Federal permit (such as an importation permit, a quarantine permit, and a release permit), or any other Federal-private nexus where the Federal government has a degree of discretionary authority.

Accordingly, although Section 7 is specific to Federal actions, non-Federal actions (in this case, the release of biological control agents into the environment) are affected whenever a Federal action is required to authorize such an action.

Consultation (Section 7(a)(3)) is the process through which the FWS advises Federal Agencies on whether their actions may affect listed species or critical habitats. The National Marine Fisheries Service (NMFS) becomes involved in consultations when a class of listed marine species or certain anadromous fish are potentially affected. This consultation is mediated through the production

---

<sup>1</sup> Critical habitat refers to an area designated as critical habitat listed in [50 CFR Parts 17](#) or [226](#).



of a draft Biological Assessment (BA) which presents all the data in the petition that relates to host plant specificity and potential effects on threatened and endangered species (Section 7(c)). This BA is reviewed by FWS to determine if they concur with the decision by APHIS to move forward with permitting the release of the novel biological control agent.

Where adverse effects are anticipated, FWS or NMFS determines whether the proposed Federal action under review is likely to jeopardize the continued existence of a listed species or destroy or adversely modify designated critical habitat. Federal actions that may affect species proposed for listing as threatened or endangered are reviewed in a conference review process (see [50 CFR 402.10](#)) that is similar to the consultation for listed species.

The consultation process can be broken into two major parts: informal and formal.

### Informal Consultation

Informal consultation is comprised of all communications between a Federal Agency (e.g., USDA-APHIS) and FWS and NMFS, that serve to determine whether the formal consultation is necessary. (For implementing regulations, see [50 CFR 402.13](#).) A table of ESA-listed species and critical habitats potentially occurring in the area directly or indirectly affected by the action can be obtained through the [U.S. Fish & Wildlife Service Information for Planning and Consultation \(IPaC\)](#) online tool or from the local FWS Office.

If the proposed action may affect, but is **not** likely to adversely affect listed species or critical habitat and the FWS concurs with the determination, then formal consultation is **not** necessary.

If listed species or habitats are present, then FWS can assist the Federal Agency by recommending project modifications that will avoid adverse impacts on species and their habitats.

A Federal Agency may designate a non-Federal representative (e.g. a petitioner) to conduct informal consultation or to prepare a biological assessment (discussed in [Biological Assessments and Effects Determination](#)) by giving written notice to the Director of the FWS. If a permit or license applicant is involved and is **not** the designated non-Federal representative, then the applicant and the Federal Agency **must** agree on the choice of the non-Federal representative ([50 CFR §402.08](#)).

### Formal Consultation

Should a Federal Agency determine that its anticipated actions may adversely affect a listed species or designated critical habitat, that Agency is required to initiate formal consultation ([50 CFR §402.14](#)) with the FWS and/or the NMFS. The Federal Agency **must** provide the FWS and/or the NMFS with a description of the proposed action and the area to be affected, and **must** include an analysis of the action's effect on listed species and designated critical habitats. (The Federal Agency may also review potential effects to proposed species and proposed critical habitat during a conference. See [50 CFR § 402.10](#).)

Section 7 and the consultation regulations ([50 CFR §402.14\(d\)](#)) require that the Federal Agency is responsible for providing the "best scientific and commercial data available or which can be obtained." The scope of what is included will likely be determined by the scope of the proposed project. Where a permit applicant or other non-Federal party is involved, the Federal Agency will frequently require that another party (e.g., petitioner) develop the required background information.

For formal consultation, the FWS and/or the NMFS has up to 90 days to complete formal consultation, and up to an additional 45 days to complete a biological opinion. Extension of the formal consultation period can be made with an agreement between agencies, however, this **cannot** exceed 60 days without the consent of the applicant. A biological opinion states whether the activity is likely to jeopardize the continued existence of the listed species and/or is likely to destroy or adversely modify designated critical habitats ([50 CFR § 402.02](#)). During these 135 days, the FWS and/or the NMFS reviews all relevant data, evaluates the current status of the listed species or critical habitats, and formulates a biological opinion.

To "jeopardize the continued existence of" means to engage in an action that is reasonably expected, directly or indirectly, to reduce appreciably the likelihood of survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species ([50 CFR § 402.02](#)).

To "destroy or adversely modify critical habitat" means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species. ([50 CFR § 402.02](#)).

In reaching these determinations, FWS and/or NMFS considers the status of the species, the environmental baseline (essentially, an evaluation of the past and present impacts within the action area prior to undertaking the proposed action), the direct and indirect effects of the action, and the cumulative effects of other anticipated actions that may affect the species.

Where a determination of jeopardy or adverse modification is made, FWS and/or NMFS **must** develop reasonable and prudent alternatives that:

- ◆ Avoid jeopardy and/or adverse modification;
- ◆ Can be implemented consistent with the intended purpose of the action;
- ◆ Are within the Agency's authority; and
- ◆ Are economically and technologically feasible.

These alternatives are developed in cooperation with the Federal Agency and the applicant (if any).

Where an applicant for a Federal permit or other Federal authorization is involved, the Federal Agency is still the entity that initiates formal consultation and FWS still produces the biological opinion. However, the applicant can review drafts of the opinion and can require that consultation **not** be extended more than 60 days beyond the normal 90-day consultation period.

The FWS and NMFS have a [Consultation Handbook](#) that provides in-depth information about ESA consultation. The FWS also provides an overview of the consultation process available at [Consultations/Overview](#).

---

## Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW) and Section 7 Consultations

One of TAG-BCAW's objectives is quite clear, "to provide an exchange of views, information, and advice for individuals who plan to ask various Federal and State regulatory agencies for permission to release these agents into the environment." Although TAG-BCAW has **no** legal mandates or authorities pertaining to the issuance of permits, TAG-BCAW's recommendations are strongly considered by decision makers.

Through the proactive participation of the FWS on the TAG-BCAW, and through the development of effective and efficient ways for the regulatory agencies to comply with Section 7 of the ESA, the problems hindering the development and implementation of biological control programs will be minimized in the future.

Part of the process for evaluating potential biological control agents of weeds is the development of a test plant list. Because the FWS TAG-BCAW member has input into the contents of the test plant list during review by the TAG-BCAW, this helps ensure that the appropriate listed plants or surrogates are included in the host specificity tests. Through the reviews of the test plant list and the final petition for release, the FWS has the opportunity to raise any known concerns and to provide for the exchange of necessary information which facilitates communications throughout the review of the proposed biological control agents of weeds program.

Petitioners should contact FWS regional offices as early in the evaluation process as possible, especially if the FWS TAG-BCAW member **did not** provide comments on the test plant list. (See [U.S. Fish and Wildlife Service \(FWS\) Regional Offices](#) on page D-1-1.)

# ESA Compliance

## *Biological Assessments and Effects Determination*

---

### Contents

Introduction	6-2-1
Biological Assessment (BA)	6-2-1
Information That Is Included in a Biological Assessment	6-2-2
Organization of Effects Determinations	6-2-7

---

### Introduction

The *Biological Assessments and Effects Determination* section of the *ESA Compliance* chapter provides information about making effects determinations and guidelines for preparing a biological assessment or biological evaluation related to introducing biological control agents of weeds. This overview is **not** intended to constitute, **nor** does it convey, legal advice.

---

### Biological Assessment (BA)

A biological assessment (BA) (sometimes referred to as a biological evaluation or BE) is a document prepared for compliance with the Endangered Species Act of 1973 (ESA) as amended. APHIS' responsibility, as the project proponent, is to prepare the BA. The purpose of a BA or a document with equivalent information, is to evaluate the effects of a project on listed species, species proposed for listing, and/or critical habitat, as well as to determine the need for formal consultation or conference (for proposed species) with the U.S. Fish and Wildlife Service (FWS) and/or the National Marine Fisheries Service (NMFS). The BA should present a line of reasoning that explains the proposed biological control agent of weed, its host specificity and potential efficacy, and how effect determinations were made for each threatened or endangered species or critical habitat that may be effected by the agent.

The permitted action for the release of a biological control agent of weeds will require both ESA and National Environmental Policy Act (NEPA) compliance. The BA should **not** be confused with the environmental assessment (EA) or the environmental impact statement (EIS), either of which may be required for NEPA compliance. The EA and EIS are designed to provide an analysis of multiple possible alternative actions on a variety of cultural, environmental, and social resources; and often use different definitions or standards, although

impacts on listed species are included in the NEPA document. The BA, as described in detail below, is an analysis of the effects on listed and proposed species and their critical habitat.

APHIS' action which triggers the requirement to comply with the ESA, is the issuance of a permit authorizing release of a biological control agent of weeds into the environment. APHIS, as the Federal Agency, is responsible for preparing the BA and consulting with FWS and NFMS.

The BA includes an analysis of potential effects to listed and proposed species and critical habitat in the entire action area. In order to prepare a BA, the petitioner will need to provide to APHIS, the items listed under [Information That Is Included in a Biological Assessment](#).

### **Information That Is Included in a Biological Assessment**

Information that is included in a Biological Assessment (BA) for release of a proposed biocontrol control agent of weeds (BCAW) is at the discretion of APHIS, but should include the following:

1. *Describe the action and the action area.*
  - A. Describe the proposed release. Include information about the proposed biological control agent of weed, including host specificity and efficacy information, and the target weed as well as plant relatives in the project area.
  - B. Describe the action area. The action area is defined by regulation as “all areas to be affected directly or indirectly by the Federal action and **not** merely the immediate area involved in the action.”

For proposed biological control agents of weeds, the project area may be the entire contiguous United States. For proposed release of a BCAW in Hawaii, the project area is usually considered to be the entire State. For release of a proposed BCAW in Guam, the action area is usually considered to be Guam and the Northern Mariana Islands.

- C. Describe current management of the target weed in the action area.
- D. Describe methods for release and post-release monitoring.
- E. Include documents, such as risk assessments, research proposals, NEPA documents, or published literature. The TAG-BCAW petition is generally the most useful information for preparing the BA. It is critical to discuss the host specificity of the proposed biological control agent of weed to the target weed and plants related to the target in the action area.

2. *What threatened or endangered (listed or proposed) species or critical habitat occur in the action area?*

A request for a species list may be submitted to the FWS and/or NMFS; APHIS may develop the list. The [U.S. Fish and Wildlife Service Environmental Conversation Online System](#), [Threatened and Endangered Species](#) web site provides species lists and information on proposed species, including species profiles and critical habitat. A list of species that may occur in a proposed BCAW release area can be generated in the [U.S. Fish and Wildlife Service's Information Planning and Consultation \(IPAC System\)](#) online tool.

It is critical for the researcher to conduct host specificity testing on listed plants (if they can be obtained) that are related to the target weed or appropriate surrogate species. Listed species such as animals or arthropods that may utilize the target weed (or other non-target plants that might be attacked by the biological control agent) as food or nectar sources, as cover, etc., will also be considered in the BA. **Do not** assume that because the listed plant **does not** occur in the same location as the target weed that there is **no** effect on a listed plant.

3. *What Federally-listed or proposed threatened or endangered species and critical habitat may be affected by the release of the BCAW, and what are those effects?*

APHIS considers the potential consequences of the release of the proposed BCAW on the listed species and critical habitat.

Direct effects are those caused by the proposed BCAW and occur at the same time as its release.

**EXAMPLE** A direct consequence could include feeding of the proposed BCAW on a listed plant which causes a decrease in size or reproduction of the plant.

A direct consequence could be a proposed BCAW that is ingested by and is toxic to a listed animal.

Indirect consequences are caused by the proposed BCAW and occur later in time, but are still reasonably certain to occur.

**EXAMPLE** An indirect consequence is feeding of the proposed BCAW on a non-listed plant species that provides breeding habitat, food, or shelter for a listed plant.

Direct or indirect consequences include any actions that could cause take (as defined by the ESA) to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct of even one individual of a listed species.

Cumulative effects are those effects of future State or private actions, **not** involving Federal actions, that are reasonably certain to occur within the target area.

It is important to consider whether the target weed is a primary physical or biological feature (sometimes referred to as primary constituent elements) of designated or proposed critical habitat for a listed species or whether the proposed BCAW could affect a physical or biological feature of the critical habitat. Physical and biological features of those that are essential to the conservation of the species. A BCAW may affect a physical or biological feature that could result in adverse modification of proposed or designed critical habitat and **must** be considered.

Sources of information about listed species and critical habitat can be found at the [U.S. Fish and Wildlife Service Environmental Conversation Online System, Threatened and Endangered Species](#) web site. Species profiles include [Federal Register](#) Notices, Recovery Plans, 5-Year Status Reviews, links to [NatureServe](#), [Integrated Taxonomic Information System \(ITIS\)](#), and other useful information. Published literature, FWS and/or NMFS and other species experts can also provide information about connections among listed species and target weeds.

Under the ESA, effect determinations are made by APHIS for the proposed release of the BCAW on proposed and listed species and designated and proposed critical habitat.

A. *No effect.* If APHIS determines that the proposed biological control agent of weed (BCAW) will have **no** effect, whether negative or positive, on any listed species or critical habitat, then **no** consultation by the FWS and/or NMFS is required and **no** action is necessary by the FWS and NFMS. A **no** effect determination is **not** appropriate if there is a small effect (e.g., an effect on a simple individual), a beneficial effect on listed species, or even if an effect is unlikely to occur.

Even though consultation is **not** required for a **no** effect determination, a record of the determination should be maintained by APHIS for the administrative record and may be included in the NEPA documentation.

B. *May effect, not likely to adversely affect.* APHIS makes this determination if the effect(s) of the proposed release of the biocontrol agent of weed (BCAW) on listed species or designated critical habitat is



discountable, insignificant, or completely beneficial. Insignificant effects relate to the size of the impact and **must never** reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur. Beneficial effects are positive effects **without** any adverse effects to species.

A may effect, **not** likely to adversely affect determination requires APHIS to seek concurrence from the FWS and NMFS.

If the FWS and NMFS agree with the determination, then they will send a concurrence letter to APHIS and the informal consultation is completed. If the FWS and NMFS **do not** concur with the APHIS finding, then the FWS and NMFS provide a written response and formal consultation is required.

- C. *May affect, likely to adversely affect.* This determination is made if the effect of the proposed BCAW on listed species or designated critical habitat is **not** discountable, insignificant, or completely beneficial. This determination requires APHIS to initiate the formal consultation process with the FWS and/or NMFS. The formal consultation process determines whether the proposed action is likely to jeopardize the continued existence of the listed species (jeopardy) or destroy or adversely modify critical habitat. See [50 CFR 402.14\(c\)\(i-vi\)](#).

Briefly, the formal consultation is as follows:

- a. APHIS submits a biological assessment (BA), including a description of the proposed action, area affected by the action, effects of the action on listed species and proposed species and critical habitat, and relevant reports, studies, or information about the action, listed species, and critical habitat.
- b. FWS and/or NMFS then prepare a biological opinion that documents their opinion as to whether the proposed action is likely to jeopardize the continued existence of the listed species, or result in the destruction or adverse modification of critical habitat.
- c. If FWS or NMFS make a jeopardy determination, then APHIS would be provided with reasonable and prudent alternative actions that would avoid jeopardy. However, for release of a BCAW there is **no** possible reasonable and prudent alternative action, and the BCAW release proposal would be withdrawn.
- d. If incidental take <sup>1</sup> is reasonably likely to occur, then biological opinions provide an exemption for the incidental take of listed species through the issuance of an incidental take statement while specifying the extent of take allowed; the reasonable and prudent

---

<sup>1</sup> Take that is incidental to, and **not** for the purpose of, the carrying out of an otherwise lawful activity.

measures necessary to minimize impacts from Federal action; and the terms and conditions with which the action Agency **must** comply.

The formal consultation process takes a minimum of 135 days.

Effect determinations include a thorough analysis of effects using the best available science with a well-supported conclusion. Assume that the FWS and/or NMFS biologist is unfamiliar with the project. Fully explain the impact the project may have on listed species. The FWS or NMFS may ask APHIS to revisit its decision and provide more data for the conclusion if it is **not** adequately supported by biological information. If this request occurs, then the statutory deadlines for formal consultation have **not** begun.

## Organization of Effects Determinations

Providing the effects determination in a table followed by a narrative summary paragraph is recommended. An example of a may affect, **not** likely to adversely affect (NLAA) is provided. When there is a **no** effect determination for a species, the information justifying that determination may be included in the B.A.

The example in [Table 6-2-1](#) documents listed species that occur in the action area and the effects analysis. The example in [Table 6-2-2](#) documents conservation measures. The information in the tables below are hypothetical to illustrate data needs and analysis details.

**Table 6-2-1 Effects Analysis and Agency Determination**

Common Name	Scientific Name	Listing Status	Critical Habitat	States of Occurrence	Impact/Effect to Breeding, Feeding, Sheltering, Migration, Nutrition, and Life Stage	Determination
Cuckoo, yellow-billed (Western US DPS)	<i>Coccyzus americanus</i>	T	N	AZ, CA, CO, MT, NV, NM, OR, TX, UT, WA, WY	B=Yes F=No S=No M=No N=No L=All	May affect, likely to be a beneficial effect on species
Vireo, blackcapped	<i>Vireo atricapilla</i>	E	N	OK, TX	B=No F=No S=No M=No N=No	<b>No effect</b> The species will <b>not</b> interact with [BCAW]
Vireo, least Bell's	<i>Vireo bellii pusilus</i>	E	Y	CA	B=Yes F=No S=No M=No N=No L=All	May affect, <b>not</b> likely to adversely affect
Orcutt grass, California	<i>Orcuttia californica</i>	E	N	CA	SEE <a href="#">Table 6-2-2</a>	May affect, <b>not</b> likely to adversely affect

Table 6-2-2 Conservation Measures for Species Identified in Table 6-2-1

Common Name	Impact/Effect to Breeding, Feeding, Sheltering, Migration, Nutrition, and Life Stage	Determination	Impact/Effects	Conservation Measure
Cuckoo, yellow-billed (Western US DPS)	B=Yes L=All	May affect, likely to be a beneficial effect on species	Nesting of the western yellow-billed cuckoo has <b>not</b> been documented in riparian stands dominated by the target weed. The target weed reduces the quality of yellow-billed cuckoo habitat. Removal of the target weed would be beneficial	None. Removal of <i>Arundo donax</i> may benefit this species and its proposed critical habitat
Vireo, least Bell's	B=Yes L=All	May affect, <b>not</b> likely to adversely affect	Target weed used by the vireo for nesting. However, the target weed is rarely used. Reports indicate that less than 1% of nests occur in the target weed [Reference]	None
Orcutt grass, California		May affect, <b>not</b> likely to adversely affect	[BCAW] could feed on this plant, affecting its survival and reproduction. This plant occurs in the subfamily as the target weed. In host specificity testing, there was no development on species belonging to this subfamily. In addition [BCAW] would be unable to survive on California orcutt grass because part of the plant's life cycle occurs in vernal pools. <i>Orcuttia</i> plants grow underwater for 3 months or more and have evolved specific adaptations for aquatic growth. Finally this grass species is an annual and could <b>not</b> support the life cycle of [BCAW]	Monitor for non-target impacts at initial release sites. If non-target impacts are observed, then report them to the FWS and/or NMFS

# TAG-BCAW Membership

## Directory

### Contents

Introduction	<b>A-1-1</b>
TAG-BCAW Membership Directory	<b>A-1-1</b>

### Introduction

The *TAG-BCAW Membership* appendix provides a list of TAG-BCAW members with their addresses and phone numbers.

### TAG-BCAW Membership Directory

**Table A-1-1 TAG-BCAW Membership Directory**

TAG-BCAW Members	Phone Number and Email Address
Dr. Sharlene E. Sing, TAG-BCAW Chair <b>USDA-Forest Service</b> Rocky Mountain Research Station Bozeman Forestry Sciences Laboratory 1648 S. 7th Avenue, MSU Campus Bozeman, MT 59717-2780	Phone: 406-312-9052 Email: <a href="mailto:sharlene.sing@usda.gov">sharlene.sing@usda.gov</a>
Mr. Gregg B. Goodman, TAG-BCAW Executive Secretary <b>USDA-APHIS-PPQ</b> 4700 River Road, Unit 133, 4C-01.48 Riverdale, MD 20737	Phone: 301-851-2074 Email: <a href="mailto:gregg.b.goodman@usda.gov">gregg.b.goodman@usda.gov</a>
Mr. Lewis John Cook <b>USDI-Bureau of Indian Affairs</b> Rocky Mountain Regional Office 316 North 26th Street Billings, MT 59101	Phone: 406-247-7946 Email: <a href="mailto:lewis.cook@bia.gov">lewis.cook@bia.gov</a>
Mr. Seth Flanigan Lead Natural Resource Specialist - Invasive Species Division of Forestry, Rangeland, and Vegetation Resources (HQ-220) <b>USDI-Bureau of Land Management</b> 1387 S. Vinnell Way Boise, ID 83709	Phone: 208-373-4094 Cell: 208-519-072 Email: <a href="mailto:sflanigan@blm.gov">sflanigan@blm.gov</a>
Dr. John Goolsby <b>USDA-Agriculture Research Service, Plains Area</b> 22675 N. Moorefield Road Moore Airbase, Building 6419 Edinburg, TX 78541	Phone: 956-373-3223 Email: <a href="mailto:john.goolsby@usda.gov">john.goolsby@usda.gov</a>

**Table A-1-1 TAG-BCAW Membership Directory (continued)**

TAG-BCAW Members	Phone Number and Email Address
<p>Mr. Nathan Harms <b>U.S. Army Corps of Engineers</b> 3909 Halls Ferry Road Vicksburg, MS 39180-0631</p>	<p>Phone: 601-634-2976 Email: <a href="mailto:nathan.e.harms@usace.army.mil">nathan.e.harms@usace.army.mil</a></p>
<p>Ms. Terri Hogan Invasive Plant Program Manager <b>USDI-National Park Service</b> Landscape Restoration &amp; Adaptation Biological Resources Division Natural Resource Stewardship and Science 1201 Oakridge Dr., Suite 200 Fort Collins, CO 80525</p>	<p>Phone: 970-267-7306 Email: <a href="mailto:terri_hogan@nps.gov">terri_hogan@nps.gov</a></p>
<p>Erica Kistner-Thomas, Ph.D. National Program Leader <b>USDA-National Institute of Food and Agriculture</b> Institute of Food Production and Sustainability Kansas City, MO</p>	<p>Phone: 816-894-9283 Email: <a href="mailto:erica.kistnerthomas@usda.gov">erica.kistnerthomas@usda.gov</a></p>
<p>Dr. Peter Mason Research Centre <b>Agriculture and Agri-Food Canada</b> K.W. Neathy Bldg. 960 Carling Avenue Ottawa, ON, Canada K1A0C6</p>	<p>Phone: 613-759-1908 Email: <a href="mailto:peter.mason@canada.ca">peter.mason@canada.ca</a></p>
<p>Mr. Joseph Milan Biological Control Specialist <b>USDI-Bureau of Land Management</b> 3948 Development Avenue Boise, ID 83705</p>	<p>Phone: 208.384.3487 Email: <a href="mailto:jmilan@blm.gov">jmilan@blm.gov</a></p>
<p>Mr. Ian Pearse <b>USGS-Fort Collins Science Center</b> 2150 Centre Ave. #C Ft. Collins, CO 80526</p>	<p>Phone: 970-226-9145 Email: <a href="mailto:ipearse@usgs.gov">ipearse@usgs.gov</a></p>
<p>Mr. James Pieper NPS Integrated Pest Management (IPM) Coordinator <b>USDI-National Park Service</b> Biological Resources Division Natural Resource Stewardship and Science 1201 Oakridge Dr., Suite 200 Fort Collins, CO 80525</p>	<p>Phone: 970-267-2144 Email: <a href="mailto:james_pieper@nps.gov">james_pieper@nps.gov</a></p>
<p>Dr. Michael Pitcairn National Plant Board Representative <b>California Dept. of Food and Agriculture</b> 3288 Meadowview Road Sacramento, CA 95832</p>	<p>Phone: 916-262-2049 Email: <a href="mailto:mpitcairn@cdfa.ca.gov">mpitcairn@cdfa.ca.gov</a></p>
<p>Ms. Kourtney Stonehouse, Acting <b>USDI-Fish and Wildlife Service</b> National Wildlife Refuge System 5275 Leesburg Pike Falls Church, VA 22041</p>	<p>Phone: 703-358-2672 Email: <a href="mailto:kourtney_stonehouse@fws.gov">kourtney_stonehouse@fws.gov</a></p>

**Table A-1-1 TAG-BCAW Membership Directory (continued)**

TAG-BCAW Members	Phone Number and Email Address
Mr. Jose Torres Subdirector de Diagnostico Fitosanitario <b>SADER SENASICA-DGSV</b> Carretera Federal Mexico-Pachuca, Km 37.5. C.P. 55740 Tecamac, Estado de Mexico Mexico 55740	Phone: (+52) (55) 5905 1000 ext.51402 Email: <a href="mailto:jose.torres@senasica.gob.mx">jose.torres@senasica.gob.mx</a>
Ms. Jolene Trujillo Invasive Species/IPM Program Coordinator <b>USDI-Bureau of Reclamation</b> Environmental Compliance Division Policy and Administration Denver Federal Center Bldg. 67 PO Box 25007 (84-53000) Lakewood, CO 80225-0007	Phone: 303-445-2903 Email: <a href="mailto:jtrujillo@usbr.gov">jtrujillo@usbr.gov</a>
Dr. Te-Ming Paul Tseng Weed Science Society of America Rep. Assistant Professor, Weed Physiology Department of Plant and Soil Sciences <b>Mississippi State University</b> Box 9555 Mississippi State, MS 39762	Phone: 662-325-4725 Email: <a href="mailto:t.tseng@msstate.edu">t.tseng@msstate.edu</a>
Ms. Tara Holtz, Acting Director of Domestic and Emergency Scientific Support <b>USDA-APHIS-PPQ</b> Science and Technology 910 Main Campus Drive, Suite 500 Raleigh, NC 27606	Phone: 919-855-7423 Cell: 919-270-9934 Email: <a href="mailto:tara.m.holtz@usda.gov">tara.m.holtz@usda.gov</a>
Vacant <b>EPA-Office of Pesticide Programs</b>	





# Forms

---

## Contents

Introduction	<b>B-1-1</b>
TAG-BCAW Reviewer's Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds	<b>B-1-2</b>
Purpose	<b>B-1-4</b>
Instructions	<b>B-1-4</b>
Distribution	<b>B-1-4</b>
TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds	<b>B-1-5</b>
Purpose	<b>B-1-7</b>
Instructions	<b>B-1-7</b>
Distribution	<b>B-1-7</b>
Instructions for Completing an Application for an APHIS Permit	<b>B-1-8</b>
Applying for an APHIS Permit	<b>B-1-8</b>
PPQ Form 526, Application to Move Live Plant Pests or Noxious Weeds	<b>B-1-9</b>
Purpose	<b>B-1-10</b>
Distribution	<b>B-1-10</b>
PPQ Form 599, Import Label for Living Regulated Organisms (Red and White)	<b>B-1-11</b>
Purpose	<b>B-1-12</b>
Distribution	<b>B-1-12</b>

---

## Introduction

The *Forms* appendix contains examples of comment sheets and forms that are used for evaluating petitions, evaluating test plant lists, or applying for permits for the biological control of weeds.

## TAG-BCAW Reviewer's Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds

**Technical Advisory Group (TAG-W) Reviewer's Comment Sheet for Field Release for Biological Control Agents of Weeds**

<b>Section 1: To be completed by the TAG Executive Secretary</b>		<b>Return Form to:</b> Gregg Goodman, Executive Secretary USDA, APHIS, PPQ 4700 River Rd, Unit 133 Office 4C-01.48 Riverdale, MD 20737-1236 Fax (301) 734-5269 Email: <a href="mailto:Gregg.B.Goodman@aphis.usda.gov">Gregg.B.Goodman@aphis.usda.gov</a>
Designation Number:	Date Request Received:	
Date Sent to Reviewers:	Review Due Date:	
	Due Date Revised:	

Biological Control Agent(s):  
.

Target Weed:

Petitioner's Name and Affiliation:

Please rate your review with one of the following categories:  
 A = Acceptable      CM = Concerns Met  
 UA = Unacceptable      CNM = Concerns Not Met      NE = Not Evaluated

---

**Section 2: To be completed by the TAG Reviewers (if needed, use additional sheets). Please change the circle to an "X" to acknowledge your choice.**

**A. Accuracy, Completeness, and Comprehensiveness:**

	A	UA	NE
Target Weed Information Comments: _	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Biological Control Agent Information Comments: _	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Experimental Methodology & Analysis Comments: _	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Test Plant Comments: __	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Results & Discussion Comments: __	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Potential Environmental Impact(s) Comments: __	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Petitioner's Conclusion Comments: __	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Figure B-1-1 Technical Advisory Group (TAG-BCAW) Reviewer's Comment Sheet - Petition for Field Release of Biological Control Agents of Weeds (front)**

Please rate your review using one of the categories.

<b>B. Thoroughness of Addressing</b>	CM	CNM	NE
Agency Concerns Comments: ___	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**C. Recommendation of Your Agency Comments:** \_\_\_

**D. Comments/list of Additional specialists':** \_\_\_

Please change the circle to an "X" to acknowledge your choice.

Recommend without reservations	<input type="radio"/>
Recommend with reservations (Please make specific comments)	<input type="radio"/>
Not recommended	<input type="radio"/>

TAG #: \_\_\_\_\_

Date: \_\_\_\_\_

Thank you for taking the time to review this petition and document your recommendations.

Figure B-1-2 Technical Advisory Group (TAG-BCAW) Reviewer's Comment Sheet - Petition for Field Release of Biological Control Agents of Weeds (back)

### **Purpose**

The Technical Advisory Group [TAG-BCAW Reviewer's Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds](#) is used by TAG-BCAW reviewers to comment, evaluate, and recommend action for petitions for field release of biological control agents of weeds.

### **Instructions**

The TAG-BCAW comment sheets are used along with the [Evaluation Checklist — Petitions for Field Release of Biological Control Agents of Weeds](#) on page 5-5 and [Evaluation Checklist for Test Plant Lists](#) on page 5-5.

### **Distribution**

The TAG-BCAW Executive Secretary distributes a fillable pdf of the [TAG-BCAW Reviewer's Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds](#) to TAG-BCAW members.

Mr. Gregg B. Goodman  
TAG-BCAW Executive Secretary  
4700 River Road, Unit 133, 4D-01.42  
Riverdale, MD 20737

E-mail: [gregg.b.goodman@aphis.usda.gov](mailto:gregg.b.goodman@aphis.usda.gov)  
FAX: 301-851-2074

TAG-BCAW reviewers return the completed [TAG-BCAW Reviewer's Comment Sheet - Petition for Field Release of Proposed Biological Control Agents of Weeds](#) to the TAG-BCAW Executive Secretary. The TAG-BCAW Executive Secretary will log in and file the recommendations, then forward to the TAG-BCAW Chair.

## TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds

### Technical Advisory Group (TAG-W) Reviewer's Comment Sheet for Test Host Plants Lists for Biological Control Agents of Weeds

**Section 1: To be completed by the TAG Executive Secretary**

Designation Number: \_\_\_\_\_ Date Request Received: \_\_\_\_\_  
 Date Sent to Reviewers: \_\_\_\_\_ Review Due Date: \_\_\_\_\_  
 Due Date Revised: \_\_\_\_\_

**Return Form to:**

Gregg Goodman, Executive Secretary  
 USDA, APHIS, PPQ  
 4700 River Rd, Unit 133  
 Office 4C-01.48  
 Riverdale, MD 20737-1236  
 Fax (301) 734-5269  
 Email: [Gregg.B.Goodman@aphis.usda.gov](mailto:Gregg.B.Goodman@aphis.usda.gov)

Biological Control Agent(s): \_\_\_\_\_

Target Weed: \_\_\_\_\_

Petitioner's Name and Affiliation: \_\_\_\_\_

Please rate your review with one of the following categories:

A = Acceptable      CN = Concerns Met  
 UA = Unacceptable      CNM = Concerns Not Met      NE = Not Evaluated

**Section 2: To be completed by the TAG Reviewers (if needed, use additional sheets). Please change the circle to an "X" to acknowledge your choice.**

**A. Accuracy, Completeness, and Comprehensiveness:**

	A	UA	NE
Target Weed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information Comments:			
<hr/>			
Test Plant List	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Comments:			
<hr/>			
Summary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Comments:			
<hr/>			
Perspective of	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Risk Comments:			

Please rate your review using one of the categories.

	CN	CNM	NE
<b>B. Thoroughness of Addressing Agency Concerns Comments:</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**C. Recommendation of Your Agency Comments:**

**Figure B-1-3 TAG-BCAW Reviewer's Comment Sheet for Test Host Plant Lists for Proposed Biological Control Agents of Weeds (front)**

**Forms**

**TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds**

---

---

**D. Comments/list of  
Additional specialists':**

Please change the circle to an "X" to acknowledge your choice.

Recommend without reservations     

Recommend with reservations        
(Please make specific comments)

Not recommended     

TAG #: \_\_\_\_\_

Thank you for taking the time to review this petition and document your recommendations.

**Figure B-1-4 TAG-BCAW Reviewer's Comment Sheet for Test Host Plant Lists for Biological Control Agents of Weeds (back)**

## Purpose

The [TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds](#) on page B-5 is used for TAG-BCAW members to comment, evaluate, and recommend action about test host plant lists.

## Instructions

The [TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds](#) is used along with the [Evaluation Guidelines for Test Plant Lists](#) on page 5-1 and [Evaluation Checklist for Test Plant Lists](#) on page 5-5.

## Distribution

The TAG-BCAW Executive Secretary distributes a fillable pdf of the [TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds](#) to TAG-BCAW reviewers.

The TAG-BCAW reviewers return their completed [TAG-BCAW Reviewer's Comment Sheet for Test Host Plants Lists for Proposed Biological Control Agents of Weeds](#) to the TAG-BCAW Executive Secretary using either of the following:

Mr. Gregg B. Goodman, TAG-BCAW Executive Secretary  
**USDA-APHIS-PPQ**  
4700 River Road, Unit 133, 4C-01.48  
Riverdale, MD 20737

Email: [gregg.b.goodman@aphis.usda.gov](mailto:gregg.b.goodman@aphis.usda.gov)

The TAG-BCAW Executive Secretary then logs and files the comments, and sends the TAG-BCAW reviewers' comment sheets to the TAG-BCAW Chair.

---

## **Instructions for Completing an Application for an APHIS Permit**

As part of the U.S. Department of Agriculture's (USDA) overall eGovernment initiative to transform and enhance delivery of its programs, services, and information, the Animal and Plant Health Inspection Service (APHIS) launched its electronic permitting system (ePermits). ePermits is a web-based tool that gives customers the ability to apply for a permit, check the status, and view the application online. All PPQ permits are processed through the ePermits system, however, there are two ways to apply for an APHIS permit: on-line or on paper.

### **Applying for an APHIS Permit**

Guidance and step-by-step instructions for obtaining regulated soil and organism permits can be found at [Plant Health Import Permits](http://www.aphis.usda.gov/plant_health/permits/organism/biological_control/weeds.shtml) at [http://www.aphis.usda.gov/plant\\_health/permits/organism/biological\\_control/weeds.shtml](http://www.aphis.usda.gov/plant_health/permits/organism/biological_control/weeds.shtml).



# PPQ Form 526, Application to Move Live Plant Pests or Noxious Weeds

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a valid OMB control number. The valid OMB control numbers for these information collections are 0579-0054 and 0579-0213. The time required to complete this information collection is estimated to average 0.17 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.						OMB APPROVED 0579-0054 and 0579-0213 EXP DATE XX/XXXX	
No permit can be issued to move live plant pests or noxious weeds until an application is received (7 CFR 330 (live plant pests) or 7 CFR 360 (noxious weeds)).							
SECTION A - TO BE COMPLETED BY THE APPLICANT							
U.S. DEPARTMENT OF AGRICULTURE ANIMAL AND PLANT HEALTH INSPECTION SERVICE PLANT PROTECTION AND QUARANTINE PERMITS AND RISK ASSESSMENT, UNIT 133 RIVERDALE, MARYLAND 20737 APPLICATION FOR PERMIT TO MOVE LIVE PLANT PESTS OR NOXIOUS WEEDS				1. NAME, TITLE, AND ADDRESS (Include ZIP Code)			
3. TYPE OF PEST TO BE MOVED <input type="checkbox"/> Pathogens <input type="checkbox"/> Arthropods <input type="checkbox"/> Noxious Weeds <input type="checkbox"/> Other (Specify) _____				2. TELEPHONE NO. (       )			
This permit does not authorize the introduction, importation, interstate movement, or release into the environment of any genetically engineered organisms or products.							
A. SCIENTIFIC NAMES OF PESTS TO BE MOVED	B. CLASSIFICATION Orders, Families, Races, or Strains)	C. LIFE STATES, IF APPLICABLE	D. NO. OF SPECIMENS OR UNITS	E. SHIPPED FROM (Country or State)	F. ARE PESTS ESTABLISHED IN U.S.?	G. MAJOR HOST S OF THE PEST	
4.							
5.							
6.							
7. WHAT HOST MATERIAL OR SUBSTITUTES WILL ACCOMPANY WHICH PESTS (Indicate by line number)							
8. DESTINATION				9. PORT OF ARRIVAL		10. APPROXIMATE DATE OF ARRIVAL OR INTERSTATE MOVEMENT	
11. NO. OF SHIPMENTS		12. SUPPLIER		13. METHOD OF SHIPMENT <input type="checkbox"/> Air Mail <input type="checkbox"/> Air Freight <input type="checkbox"/> Baggage <input type="checkbox"/> Auto			
14. INTENDED USE. Be specific, attach outline of intended research							
15. METHODS TO BE USED TO PREVENT PLANT PEST ESCAPE				16. METHOD OF FINAL DISPOSITION			
17. Applicant must be a resident of the U.S.A. SIGNATURE OF APPLICANT (Must be person named in Item 1)						18. DATE	
I/We agree to comply with the safeguards printed on the reverse of this form, and understand that a permit may be subject to other conditions specified in Section B and C.							
WARNING: Any alteration, forgery, or unauthorized use of this document is subject to civil penalties of up to \$250,000 (7 U.S.C. s7734(b)) or punishable by a fine of not more than \$10,000, or imprisonment of not more than 5 years, or both (18 U.S.C. s1001).							
				SECTION B - TO BE COMPLETED BY STATE OFFICIAL			
19. RECOMMENDATION <input type="checkbox"/> Concur (Approve) <input type="checkbox"/> (Accept USDA Decision)				20. CONDITIONS RECOMMENDED <input type="checkbox"/> Comments (Disapprove)			
21. SIGNATURE		22. TITLE		23. STATE		24. DATE	
				SECTION C - TO BE COMPLETED BY FEDERAL OFFICIAL			
				25. PERMIT NO.			
PERMIT							
(Permit not valid unless signed by an authorized official of the Animal and Plant Health Inspection Service)							
Under authority of the Plant Protection Act of 2000, permission is hereby granted to the applicant named above to move the pests described, except as deleted, subject to the conditions stated on, or attached to this application. (See standard conditions on reverse side.)							
For exotic plant pathogens, attach a completed PPQ Form 526-1.							
26. SIGNATURE OF PLANT PROTECTION AND QUARANTINE OFFICIAL		27. DATE		28. LABELS ISSUED		29. VALID UNTIL	
						30. PEST CATEGORY	
PPQ FORM 526 DEC 2011				Previous editions are obsolete.			

Figure B-1-5 PPQ Form 526, Application to Move Live Plant Pets or Noxious Weeds

## Purpose

PPQ Form 526, [Application to Move Live Plant Pests or Noxious Weeds](#), is the application used to request a USDA-APHIS-PPQ permit for the following activities:

- ◆ Import plant pests, including but **not** limited to the following living organisms: biological control organisms, earthworms, honeybees and other pollinating bees, insects, mites, nematodes, slugs, snails; microbes pathogenic to plants or invertebrates; parasitic plants, or other Federal noxious weeds into the environment of the United States
- ◆ Ship interstate any of the above **except** entomophagous insects and honeybees
- ◆ Release any organisms including those for biological control purposes, from containment into the environment of the United States

### NOTICE

**Do not** use this form (PPQ Form 526) for genetically-engineered plants or genetically-engineered plant pests.

Use APHIS Form 2000 for genetically-engineered plants or genetically-engineered plant pests.

## Distribution

See [Instructions for Completing an Application for an APHIS Permit](#) on page B-8.


## PPQ Form 599, Import Label for Living Regulated Organisms (Red and White)

This Package Contains  
**LIVING REGULATED ORGANISMS**  
*DO NOT OPEN EXCEPT IN THE PRESENCE OF AN APHIS  
 INSPECTOR OR DESIGNATED REPRESENTATIVE OF USDA.*

**DELIVER TO**

**U.S. DEPARTMENT OF AGRICULTURE**  
 ANIMAL AND PLANT HEALTH INSPECTION SERVICE  
 PLANT PROTECTION AND QUARANTINE

Label # 13 Exp 05/11/2009

 Miami Inspection Station  
 3500 N.W. 62nd Avenue  
 P.O. Box 59-2136  
 305-526-2825  
 Miami, FL 33159 USA

PPQ FORM 599 (SEP 2006) **PERMIT NO. P330-07-00281**

Figure B-1-6 Example of PPQ Form 599, Import Label for Living Regulated Organisms (red and white shipping label) (adhesive label issued before September 9, 2014, but valid until expiration date on permit)

Red&White Red&White Red&White Red&White Red&White Red&White Red&White Red&White

This Package Contains  
**LIVING REGULATED ORGANISMS**  
*DO NOT OPEN EXCEPT IN THE PRESENCE OF AN APHIS  
 INSPECTOR OR DESIGNATED REPRESENTATIVE OF USDA*

**DELIVER TO**

**U.S. DEPARTMENT OF AGRICULTURE**  
 ANIMAL AND PLANT HEALTH INSPECTION SERVICE  
 PLANT PROTECTION AND QUARANTINE

Label # 70 Exp 08/04/2015

 National Plant Germplasm  
 Inspection Station  
 USDA PPQ (301-313-9327)  
 Bldg. 580, BARC-East  
 Beltsville, MD 20705

PPQ FORM 599 (SEP 2006) **PERMIT NO. P526P-14-00217**

Red&White Red&White Red&White Red&White Red&White Red&White Red&White Red&White

Table B-1-1 PPQ Form 599, Import Label for Living Regulated Organisms (red and white label) Mailing or Shipping (new plain paper (nongummed) or special adhesive (gummed) label issued starting September 9, 2014)

## Purpose

PPQ Form 599, Import Label for Living Regulated Organisms (Red and White), is a red and white shipping label issued by the USDA-APHIS-PPQ Permit Unit to denote shipping or mailing regulated articles into the U.S. The PPQ Form 599 label designates a package as containing living organisms regulated under an APHIS PPQ permit (see [PPQ Form 526, Application to Move Live Plant Pests or Noxious Weeds](#)). The organisms (plant pests or pathogens) usually fall into one of the following categories: bees, biological control agents, live insects, noxious weeds, parasitic plants, plant pathogens, plant pests, select agents, snails, or worms.

For shipping or mailing, the red and white label includes the APHIS permit number and the address where inspection is authorized. Inspections usually (but **not always**) occur at a PPQ plant inspection station. The label authorizes movement of a secure and intact package to the address on the label.

APHIS is phasing in the use of printable plain paper (nongummed) labels for permitted Plant Protection and Quarantine imports that require a label. The new, plain paper labels are the ePermits default choice. The plain paper labels are sent via email to the permittee as a PDF attachment. The permittee may then distribute permit labels to shippers by email or regular mail. The shipper is instructed to print the plain paper label using a color, and then attach the label to the package exterior using clear tape.

The permittee may request and be issued plain paper labels, special gum labels, or a combination of both. The permittee needs to specify either plain paper labels or special gum labels for each request. If both types of labels are issued for the same permit, then the label numbers remain sequential. There may be a slight change in appearance of the plain paper (nongummed) labels, because printer ink may vary in color and intensity and the labels will be affixed using clear tape. If there is a failure to print the labels in color, then shipments can and will be refused and/or ordered destroyed.

## Distribution

PPQ Form 599, Import Label for Living Regulated Organisms (Red and White Label), is distributed by the USDA-APHIS-PPQ Pest Permitting Branch.

# NAPPO Standard

---

## Contents

Introduction	C-1-1
Requirements	C-1-1

---

## Introduction

The *NAPPO Standard* appendix provides the North American Plant Protection Organization (NAPPO) standard that may be used as a reference. This document is a regional (North American) plant protection standard agreed upon by Canada, Mexico, and the United States, outlining the minimum requirements for information to be included in a petition to regulatory officials. Additional information may be required by regulatory officials in one or more of these countries.

### NOTICE

Petitioners in Canada and Mexico are required to follow the NAPPO Standard, RSPM 7, which is similar to the format in [Format for Petitions for Field Release](#) on page 5-1-2 and [Format for Test Plant Lists](#) on page 5-3-2.

---

## Requirements

Each petition should be preceded by a title page, a table of contents, and a summary or abstract.

Petitioners from the United States will follow the procedures as stated in [Format for Petitions for Field Release](#) on page 5-1-2 and [Format for Test Plant Lists](#) on page 5-3-2. Submitting a TAG-BCAW petition (following the procedures as stated in [Petitions for Field Release Format](#) of this manual) satisfies the NAPPO standard for proposed environmental releases in the U.S.

Petitioners from Canada and Mexico will follow the NAPPO standard, [RSPM 7 Guidelines for Petition for First Release of Non-indigenous Phytophagous or Phytopathogenic Biological Control Agents](#) from the [NAPPO Regional Standards for Phytosanitary Measures](#). RSPM 7.



# Fish and Wildlife Service Offices

## Directory

### Content

Introduction **D-1-1**

U.S. Fish and Wildlife Service (FWS) Regional Offices **D-1-1**

### Introduction

The *Fish and Wildlife Service Offices* appendix provides a list of U.S. Fish and Wildlife Service (FWS) Regional Offices and contact information.

### U.S. Fish and Wildlife Service (FWS) Regional Offices

Petitioners and researchers may contact the appropriate U.S. FWS Regional Office early in the petition process for advice and input regarding Section 7 of the Endangered Species Act

**Table D-1-1 Directory of U.S. Fish and Wildlife Service (FWS) Regional Offices**

FWS Region	Area of Coverage	FWS Office Address	Phone Number
Region 1	Hawaii Idaho Oregon Washington Pacific Islands	Division of Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> 911 NE 11th Avenue Portland, OR 97232-4181  <a href="http://www.fws.gov/program/ecological-services/contact-us">http://www.fws.gov/program/ecological-services/contact-us</a>	503-231-6151
Region 2	Arizona New Mexico Oklahoma Texas	Division of Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> PO Box 1306 Albuquerque, NM 87103-1306  <a href="http://www.fws.gov/program/ecological-services/contact-us">http://www.fws.gov/program/ecological-services/contact-us</a>	505-248-6651
Region 3	Illinois Indiana Michigan Minnesota Missouri Ohio Wisconsin	Division of Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> 5600 American Blvd. West, Suite 990 Bloomington, MN55437-1458  <a href="http://www.fws.gov/program/ecological-services/contact-us">http://www.fws.gov/program/ecological-services/contact-us</a>	612-713-5334

**Fish and Wildlife Service Offices**

U.S. Fish and Wildlife Service (FWS) Regional Offices

**Table D-1-1 Directory of U.S. Fish and Wildlife Service (FWS) Regional Offices (continued)**

FWS Region	Area of Coverage	FWS Office Address	Phone Number
Region 4	Alabama Arkansas Florida Georgia Kentucky Louisiana Mississippi North Carolina South Carolina Tennessee	Division of Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> 1875 Century Boulevard, Suite 200 Atlanta, GA 30345  <a href="http://www.fws.gov/program/ecological-services/contact-us">http://www.fws.gov/program/ecological-services/contact-us</a>	850-877-6513
Region 5	Connecticut Delaware District of Columbia Maine Maryland Massachusetts New Hampshire New Jersey New York Pennsylvania Rhode Island Vermont Virginia West Virginia	Division of Threatened and Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> 300 Westgate Center Drive Hadley, MA 01035-9589  <a href="http://www.fws.gov/program/ecological-services/contact-us">http://www.fws.gov/program/ecological-services/contact-us</a>	413-253-8615
Region 6	Colorado Kansas Montana Nebraska North Dakota South Dakota Utah Wyoming	<i>Mailing Address:</i> Division of Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> PO Box 25486, DFC Denver, CO 80225  <i>Physical Address:</i> Division of Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> 134 Union Blvd., Suite 650 Lakewood, CO 80228  <a href="http://www.fws.gov/program/ecological-services/contact-us">http://www.fws.gov/program/ecological-services/contact-us</a>	303-236-4046
Region 7	Alaska	Division of Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> 1011 East Tudor Road Anchorage, AK 99503  <a href="http://www.fws.gov/program/ecological-services/contact-us">http://www.fws.gov/program/ecological-services/contact-us</a>	907-786-3323
Region 8	California Nevada	Division of Endangered Species <b>U.S. Fish and Wildlife Service (FWS)</b> 2800 Cottage Way, Suite W2606 Sacramento, CA 95825  <a href="http://www.fws.gov/program/ecological-service/contact-us">http://www.fws.gov/program/ecological-service/contact-us</a>	916-414-6600



# Plant Classification System

---

## Contents

Introduction	E-1-1
Plant Classification System	E-1-1

---

## Introduction

The *Plant Classification System* appendix provides information about the plant classification systems that are in use today.

---

## Plant Classification System

The risk of non-target impacts is examined through host specificity testing of the proposed biological control agent of weeds. Post-release monitoring of control agents has shown that the highest level of risk is to those plants most closely related, in terms of phylogenetic (evolutionary) relatedness, to the target plant (Pemberton 2000). Construction of the host test plant list gives higher emphasis to those plants closely related to the target weed and less emphasis to more distantly related non-target plants. This method of test plant list construction is called the “Wapshere method” (after Wapshere (1974) who first proposed the method) or the “centrifugal phylogenetic method.” Two things are required for this method to be effective: accurate identification of the target weed and an accurate understanding of the target’s phylogenetic relationship with non-target plants.

The field of plant taxonomy and systematics has undergone major changes in the last 30 years. The most profound is the development of molecular taxonomy and a corresponding systematics that has led to a large source of new data for use in phylogenetic analyses and a better understanding of the evolutionary relationships among plant groups.

Changes in nomenclature and modification of phylogenetic hypotheses are ongoing. As a result, the best sources of current taxonomic nomenclature and plant phylogenies are Web sites that are updated frequently.

For the current nomenclature of a target weed, petitioners should use accurate databases and consult with a plant taxonomist.

The use of molecular methods has also resulted in changes to our understanding of the evolutionary relationships among plants. In particular, molecular data have identified a number of traditional taxonomic groups that are polyphyletic and comprised of unrelated molecular lineages, that is, groups that have similar morphology due to convergent evolution but **do not** share a most recent ancestor. Conversely, some groups that appear morphologically dissimilar have been found to be closely related. A recent example of a major change to a traditional family is the breakup of the family Scrophulariaceae. Previously, this family contained a number of weedy genera, such as *Linaria*, *Verbascum*, and [now] *Plantago*. Recently, based on molecular data, it has been shown to have been composed of at least five distinct monophyletic groups (Olmstead et al. 2001). While the family Scrophulariaceae still exists, it is now comprised of **only** a few small genera, as each of the monophyletic groups has been merged with other families to which they are more closely related.

A recent description of the phylogeny of plant families based on the latest molecular data was published by Haston et al. (2007) where an evolutionary tree illustrating the phylogeny was presented. Petitioners should consult this paper to learn what families are most closely related to the target weed's family.

Any changes and updates to Haston et al. are posted on the [Angiosperm Phylogeny Web site](http://www.mobot.org/mobot/research/apweb/), <http://www.mobot.org/mobot/research/apweb/>, a Web site maintained by Peter Stevens of the Missouri Botanical Garden. Petitioners are to check this Web site and cite as follows:

“Stevens, P. F. (date of access). Angiosperm Phylogeny Web site. Version #, date of last update.”

### References

- Haston, E., J. E. Richardson, P. F. Stevens, M. W. Chase, and D. J. Harris. 2007. A linear sequence of Angiosperm Phylogeny Group II families. *Taxon* 56(1): 7-12.
- Olmstead, R. G., C. W. dePamphilis, A. D. Wolfe, N. D. Young, W. J. Elisons, and P. A. Reeves. 2001. Disintegration of the Scrophulariaceae. *American Journal of Botany* 88(2): 348-361.
- Pemberton, R. W. 2000. Predictable risk to native plants in weed biological control. *Oecologia* (Berlin) 125: 489-494.
- Wapshere, A. J. 1974. A strategy for evaluating the safety of organisms for biological weed control. *Annals of Applied Biology* 77: 201-211.

# References

---

## Contents

Introduction	<b>F-1-2</b>
General References	<b>F-1-2</b>
Articles	<b>F-1-2</b>
Books	<b>F-1-3</b>
Websites	<b>F-1-4</b>
Biological Control Agents	<b>F-1-5</b>
Articles	<b>F-1-5</b>
Audiovisual Materials	<b>F-1-6</b>
Books and Periodicals	<b>F-1-6</b>
Recognized Taxonomic Institutions	<b>F-1-8</b>
Websites	<b>F-1-9</b>
Biological Control of Weeds	<b>F-1-10</b>
Articles	<b>F-1-10</b>
Books	<b>F-1-12</b>
Websites	<b>F-1-13</b>
Economic Botany	<b>F-1-15</b>
Books	<b>F-1-15</b>
Websites	<b>F-1-15</b>
Plant Taxonomy and Distribution	<b>F-1-16</b>
Articles	<b>F-1-16</b>
Audiovisual Materials	<b>F-1-16</b>
Books	<b>F-1-16</b>
Websites	<b>F-1-18</b>
Protected Species	<b>F-1-20</b>
Websites	<b>F-1-20</b>
Risk Assessment	<b>F-1-21</b>
Articles	<b>F-1-21</b>
Books	<b>F-1-24</b>
Websites	<b>F-1-24</b>
Testing Methodology for Biological Control	<b>F-1-25</b>
Articles	<b>F-1-25</b>
Books	<b>F-1-28</b>
Websites	<b>F-1-28</b>

---

## Introduction

The *References* appendix contains a list of reading material suggested by the Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW).

---

## General References

### Articles

Briese, D.T. 2004 “Weed biological control: applying science to solve seemingly intractable problems.” *Australian Journal of Entomology* 43: 304-317.

Clewley, G.D., R. Eschen, R.H. Shaw, and D.J. Wright. 2012. “The effectiveness of classical biological control of invasive plants.” *Journal of Applied Ecology* 49: 1287-1295.

Cuda, J.P., R. Charudattan, M.J. Grodowitz, J.F. Shearer, R.M. Newman, M.L. Tamayo, and B. Villegas. 2008. “Recent advances in biological control of submersed aquatic weeds.” *Journal of Aquatic Plant Management* 46: 15-32.

Culliney, T.W. 2005. “Benefits of classical biological control for managing invasive plants.” *Critical Reviews in Plant Science* 24: 131-150.

Denoth, M.; L. Frid, and J.H. Meyers. 2002. “Multiple agents in biological control: improving the odds?” *Biological Control* 24: 20-30.

Gaskin, John F., Marie-Claude Bon, Matthew J.W. Cock, Massimo Cristofaro, Alessio De Biase, Rose De Clerck-Floate, Carol A. Ellison, Harriet L. Hinz, Ruth A. Hufbauer, Mic H. Julien, and René Sforza. 2011. “Applying molecular-based approaches to classical biological control of weeds.” *Biological Control* 58: 1-21.

Ghosheh, H.Z. 2005. “Constraints in implementing biological weed control: A review.” *Weed Biology and Management* 5: 83-92.

Hodde, Mark S. 2004. “Restoring balance: using exotic species to control exotic invasive species.” *Conservation Biology* 18: 38-49.

Julien, Mic and Graham White (eds.). 1997. “Biological Control of Weeds: theory and practical application.” *ACIAR Monograph* 49: 1-192.

Lym, R.G. 2005. "Integration of biological control agents with other weed management technologies: Successes from the leafy spurge (*Euphorbia esula*) IPM program." *Biological Control* 35: 366-375.

McFadyen, Rachel E. Cruttwell. 1998. "Biological Control of Weeds." *Annual Review of Entomology* 43: 369-393.

Mills, N.J. and J.M. Kean. 2010. "Behavioral studies, molecular approaches, and modeling: Methodological contributions to biological control success." *Biological Control* 52: 255-262.

Müller-Schärer, H. and U. Schaffner. 2008. "Classical biological control. exploiting enemy escape to manage plant invasions." *Biological Invasions* 10: 859-874.

Olckers, T., and M.P. Hill (Eds). 1999. "Biological control of weeds in South Africa (1990-1998)." *African Entomology Memoir No. 1* 182. pp.

Paynter, Q., J.M. Overton, R.L. Hill, S.E. Bellgard, and M.I. Dawson. 2012. "Plant traits predict the success of weed biocontrol." *Journal of Applied Ecology* 49: 1140-1148.

Raghu, S. and R.D. van Klinken. 2006. "Refining the Ecological Basis of Agent Selection in Weed Biological Control." *Australian Journal of Entomology* 45(4): 251-365.

Van Wilgen, B.W. and W. J. De Lange. 2011. "The costs and benefits of biological control of invasive alien plants in South Africa." *African Entomology* 19. 504-514.

Wang, Y., W. Huang, E. Siemann, Z. Jianwen, G.S. Wheeler, J. Carrillo, and J. Ding. 2011. "Lower resistance and higher tolerance of invasive host plants: biological control agents reach high densities but exert weak control." *Ecological Applications* 21:729-738.

### Books

Coombs, E.M., J.K. Clark, G.L. Piper and A.F. Cofrancesco, Jr. (eds). 2004. *Biological Control of Invasive Plants in the United States*. Oregon: Oregon State University Press. 467 pp.

Gurr, Geoff and Steve Wratten (eds). 2000. *Biological Control: Measures of Success*. Dordrecht, Netherlands: Kluwer Academic Publishers. 429 pp.

Hajek, Ann E. 2004. *Natural Enemies: An Introduction to Biological Control*. Cambridge, United Kingdom: Cambridge University Press. 378 pp.

## References

### General References

---

Julien, M. H., R.E.C. McFadyen, and J.M. Cullen (eds). 2012. *Biological Control of Weeds in Australia*. Melbourne, Australia: CSIRO Publishing. 648 pp.

Maniappan, R., G.V.P. Reddy and A. Raman (eds). 2009. *Biological Control of Tropical Weeds Using Arthropods*. Cambridge, United Kingdom: Cambridge University Press, 495 pp.

Mason, P.G. and J.T. Huber (eds). 2013. *Biological Control Programmes in Canada, 2001-2012*. Wallingford, United Kingdom: CABI Publishing. 544 pp.

Mason, P.G. and J.T. Huber (eds). 2001. *Biological Control Programmes in Canada, 1981-2000*. Wallingford, United Kingdom: CABI Publishing. 608 pp.

Spafford, J.H. and D.T. Briese. 2002. *Improving the Selection, Testing, and Evaluation of Weed Biological Control Agents. Technical Series No. 7*, Adelaide, Australia: Cooperative Research Centre for Australian Weed Management. 7: 1-99. 110 pp.

Van Driesche, R., M. Hoddle, and T. Center. 2008. *Control of Pests and Weeds by Natural Enemies: An Introduction to Biological Control*. Malden, MA: Blackwell Publishing. 473 pp.

Withers, T.M., L. B. Brown, and J. Stanley (eds). 1999. *Host Specificity Testing in Australasia: towards improved assays for biological control*. Cooperoo, Queensland, Australia: Department of Natural Resource. 98 pp.

### Websites

[“Biological control of weeds,”](#) CSIRO, last modified February 1, 2013.

[“Improving the Selection, Testing, and Evaluation of Weed Biological Control Agents,”](#) CRC for Australian Weed Management, April 2003.

## Biological Control Agents

---

### Articles

Bruckart, W.L. and N. Shishkoff. 1993. "Foreign plant pathogens for environmentally safe biological control of weeds." In: Lumsden, R. D. and J.L. Vaughan (eds). *Pest Management: Biologically Based Technologies*. Beltsville Symposium - 18, American Chemical Society, Washington, DC. 224-230.

Bruckart, W.L., D.M. Supkoff, and S.M. Yang. 1996. "Indigenous plant pathogens in evaluations of foreign biological control candidates in the United States of America." In: Proceedings of the IX International Symposium on Biological Control of Weeds. Stellenbosch, South Africa.

Cullen, J.M. 1988. "Current problems in host-specificity screening." In Proceedings VII of the International Symposium of Biological Control of Weeds: 27-36.

Franks, S.J., P.D. Pratt, and N.D. Tsutsui. 2011. "The genetic consequences of a demographic bottleneck in an introduced biological control insect." *Conservation Genetics* 12: 201-211.

Harris, Peter, and Peter McEvoy. 1995. "The predictability of insect host plant utilization from feed tests and suggested improvements for screening weed biological control agents." *Proceedings of the VII International Symposium of Biological Control of Weeds. Melbourne* 125-131. DSI/CSIRO.

Herrick, N. J. and L. T. Kok. 2010. "Classical biological control of weeds with Curculionidae." *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources* 5 (028): 1-11.

Morin, L., A.M. Reid, N.M. Sims-Chilton, Y.M. Buckley, K. Dhileepan, G.T. Hastwell, T.L. Nordblom, and S. Raghu. 2009. "Review of approaches to evaluate the effectiveness of weed biological control agents." *Biological Control* 51: 1-15.

Myers, J.H., C. Jackson, H. Quinn, S.R. White, and J.S. Cory, 2009. "Successful biological control of diffuse knapweed, *Centaurea diffusa*, in British Columbia, Canada." *Biological Control* 50: 66-72.

Paynter, Q., and S. Bellgard. 2011. "Understanding dispersal rates of invading weed biocontrol agents." *Journal of Applied Ecology*. 48: 407-414.

Schwarzlaender, M., H.L. Hinz, and R. Wittenberg. 1996. "Oogenesis requirements and weed biological control: an essential part in host-range

evaluation of insect agents or just wasted time?” *Proceedings of the IX International Symposium on Biological Control of Weeds*. Stellenbosch, South Africa: University of Cape Town. 79-85.

Shearer, J.F. 2012. “A historical perspective of pathogen biological control of aquatic plants.” *Weed Technology* 24: 202-207.

Skoracka, A.L., L. Smith, G. Oldfield, M. Cristofaro, and J. Amrine. 2010. “Host-plant specificity and specialization in eriophyoid mites and their importance for the use of eriophyoid mites as biocontrol agents of weeds.” *Experimental and Applied Acarology* 51: 93-113.

Smith, L., E. de Lillo, and J. Amrine. 2010. “Effectiveness of eriophyid mites for biological control of weedy plants and challenges for future research.” *Experimental and Applied Acarology* 51(1-3): 115-149.

Van Hezewijk, B.H., R.S. Bouchier, and R.A. De Clerck-Floate. 2010. “Regional-scale impact of the weed biocontrol agent *Mecinus janthinus* on Dalmation toadflax (*Linaria dalmatica*).” *Biological Control* 55(3): 197-202.

### **Audiovisual Materials**

Noxious and Nuisance Plant Management Information System (PMIS). CD-ROM. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

### **Books and Periodicals**

Batra, S.W.T., J.R. Coulson, P.H. Dunn, and P.E. Boldt. 1981. “Insects and fungi associated with carduus thistles.” USDA ARS Technical Bulletin 1616.1981.100 pp.

Center, T.D., G. Jubinsky, and F. Dray. 1992. “Biological control of aquatic weeds, insects that feed on aquatic plants.” In: *Biology and Identification Manual*.

Coulson, J.R. 1977. “Biological control of alligatorweed, 1959-1972: a review and evaluation. USDA, Technical Bulletin 1547.

Goeden, R.D. 1978. “Biological control of weeds.” In: *Introduced parasites and predators of arthropod pests and weeds: a world review*. U.S. Department of Agriculture, Handbook 480: 357-414.

Harley, K.L.S. and I.W. Forno. 1992. *Biological control of weeds; a handbook for practitioners and students*. Melbourne: Inkata Press. 74pp.



Julien, M.H. 1992. *Biological Control of Weeds: A world catalogue of agents and their target weeds*. Third edition. Wallingford: CAB International.

Julien, M.H. (author) and M.W. Griffiths (ed.). 1998. *Biological Control of Weeds: a World Catalogue of Agents and their Target Weeds*. 4th edition. CABI Publishing, Wallingford, United Kingdom.

McFadyen, Rachel E. Crutwell. 1998. "Biological Control of Weeds." *Annual Review of Entomology* 43: 369-393.

Rees, N.E., P.C. Quimby, G.L. Piper, E.M. Coombs, C.E. Turner, N.R. Spencer, and L.V. Knutson. 1996. *Biological Control of Weeds in the West*. Western Society of Weed Science.

Van Driesche, R., S. Lyon, B. Blossey, M. Hoddle, and R. Reardon. 2002. *Biological Control of Invasive Plants in the Eastern United States*. USDA Forest Service. Forest Health Technology Enterprise Team Publication. FHTET-2002-04. 413 pp.

## Recognized Taxonomic Institutions

### United States

USDA, ARS, Plant Sciences Institute  
Systematic Entomology Laboratory  
Bldg. 005, Room 133, BARC-West  
10300 Baltimore Blvd.  
Beltsville, MD 20705-2350

USDA, ARS  
Systematic Mycology and Microbiology Laboratory  
Dr. Amy Rossman, Mycology  
Bldg. 011A, Room 304, BARC-West  
10300 Baltimore Avenue  
Beltsville, MD 20705

USDA, ARS  
National Germplasm Resources Laboratory  
Dr. John Wiersema, Plant Taxonomy  
Building 003, Room 124, BARC-West  
Beltsville, MD 20705-2350  
E-mail: john.wiersema@ars.usda.gov

### Canada

Dr. Owen Lonsdale, Collections Manager  
Canadian National Collection of Insects, Arachnids and Nematodes  
Agriculture and Agri-Food Canada/Agriculture et Agroalimentaire Canada  
KW Neatby Building  
960 Carling Avenue  
Ottawa, ON KIA 0C6  
CANADA

Telephone/Téléphone: 613-759-1992  
FAX/Télécopieur: 613-759-1927  
Email: owen.lonsdale@agr.gc.ca

### Mexico

Colección Nacional de Insectos  
Instituto de biología, UNAM  
Aptado Postal 70-153  
04510 México, D.F.  
MÉXICO

Telephone 56-22-91-67 ext. 47821  
Email: mayorga@ibiologia.unam.mx

### Websites

“[BCANZ—Biological Control Agents introduced to New Zealand](#),” Ferguson, C.M., Moeed, A., Barrett, B.I.P., Hill, R.L., and Kean, J.M, Better Border Security New Zealand, 2007.

“[Biological Control: A Guide to Natural Enemies in North America - Weed-feeders](#),” Cornell University. New York State Agricultural Experiment Station, Department of Entomology, accessed June 17, 2013.

“[Biological Control of Pests in the Forests of Eastern United States](#),” University of Massachusetts Amherst, accessed June 17, 2013.

“[Publications, Biological Control](#),” United States Department of Agriculture, Forest Service, accessed June 17, 2013.

“[Releases of Beneficial Organisms in the United States and Territories \(ROBO\)](#)” United States Department of Agriculture, Agriculture Research Service, National Invertebrate Genetic Resources, Biological Control Documentation Center, accessed June 17, 2013).

## Biological Control of Weeds

### Articles

Cavers, P.B. (ed.). 1995. "The Biology of Canadian Weeds." Agricultural Institute of Canada, Ottawa, Ontario, Canada, 3: 62-83.

Cavers, P.B., and S.I. Warwick. 2000. "The Biology of Canadian Weeds." *Canadian Journal of Plant Science* 80: 237-240.

Cavers, P.B., S.I. Warwick, and D.R. Clements. 2003. "The Biology of Canadian Weeds." *Canadian Journal of Plant Science* 83: 661-665.

Cavers, P.B. (ed). 2005. "The Biology of Canadian Weeds." Agricultural Institute of Ottawa, Ontario, Canada. 5:103-129

Cripps, M.G., A. Gassmann, S.V. Fowler, G.W. Bourdôt, A.S. McClay, and G.R. Edwards. 2011. "Classical biological control of *Cirsium arvense*: Lessons from the past." *Biological Control* 57: 165-174.

Coulson, Jack R. 1992. "Documentation of classical biological control introductions." *Crop Protection* 11(3): 195-205.

Cullen, J.M. 1988. "Current problems in host-specificity screening." *Proceedings of the VII International Symposium of Biological Control of Weeds*. Melbourne. 27-36.

Cullen, J.M. 1995. "Predicting effectiveness: fact and fantasy." *Proceedings of the VIII International Symposium of Biological Control of Weeds*. Melbourne. 103-109.

Dunn, P.H. 1976. "Shortcomings in classic tests of candidate insects for the biocontrol of weeds." *Proceedings of the IV International Symposium on Biological Control of Weeds*; Gainesville, FL 51-56.

Harris, P., and H. Zwölfer. 1968. "Screening phytophagous insects for biological control of weeds." *The Canadian Entomologist* 100: 295-303.

Harris, Peter, and P. McEvoy. 1995. "The predictability of insect host plant utilization from feeding tests and suggested improvements for screening weed biological control agents." *Proceedings of the VIII International Symposium of Biological Control of Weeds*; Melbourne: 125-131.

Hoffmann, J.R. 1991. "Biological control of weeds in South Africa." *Agriculture, Ecosystems and Environment* 37: 255.

Klingman, D.L., and J.K. Coulson. 1983. "Guidelines for introducing foreign organisms into the United States for the biological control of weeds." *Bulletin of the Entomological Society of America* 29 (3): 55–61.

Lesica, Peter, and Dave Hanna. 2009. "Effect of Biological Control on Leafy Spurge (*Euphorbia esula*) and Diversity of Associated Grasslands over 14 Years." *Invasive Plant Science and Management* 2: 151-157.

McClay, A.S. 1989. "Selection of suitable target weeds for classical biological control in Alberta." Alberta Environmental Centre, Vegreville, AECV89-R1.

McFadyen, Rachel E. Cruttwell. 1998. "Biological Control of Weeds." *Annual Review of Entomology* 43: 369-93.

Morin, L., A.M. Reid, N.M. Sims-Chilton, Y.M. Buckley, K. Dhileepan, G.T. Hastwell, T.L. Nordblom, and S. Raghu. 2009. "Review of approaches to evaluate the effectiveness of weed biological control agents." *Biological Control* 51: 1-15.

Myers, Judith H., Caroline Jackson, Hillary Quinn, Shannon R. White, and Jenny S. Cory. 2009. "Successful biological control of diffuse knapweed, *Centaurea diffusa*, in British Columbia, Canada." *Biological Control* 50: 66-72.

Samuel L.W., D.R. Kirby, J.E. Norland, G.L. Anderson. 2008. "Leafy spurge suppression by flea beetles in the Little Missouri Drainage Basin, U.S.A." *Rangeland Ecology and Management* 61: 437-443.

Shepherd, Rosamond C.H. 1989. "Problems which arise with host-specificity testing of insects." *Proceedings of the VII International Symposium of Biological Control of Weeds*; 6–11 March 1988; Rome, Italy: Instituto Sperimentale per la Patologia Vegetale (MAF): 85–92.

Van Hezewijk, B.H., R.S. Bouchier, and R.A. De Clerck-Floate. 2010. "Regional-scale impact of the weed biological control agent *Mecinus janthinus* on Dalmatian toadflax (*Linaria dalmatica*)." *Biological Control* 55: 197-202.

Wapshere, A.J. 1974a. "Host specificity of phytophagous organisms and the evolutionary centres of plant genera or sub-genera." *Entomophaga* 19: 301–309.

Wapshere, A.J. 1974b. "A strategy for evaluating the safety of organisms for biological weed control." *Annals Applied Biology* 77: 201–211

Wood, R.K.S., and M.J. Way (eds). 1988. "Biological control of pests, pathogens and weeds: developments and prospects." Proceedings of a Royal Society Discussion Meeting; London.

Zwölfer, H., and P. Harris. 1971. "Host specificity determination of insect for biological control of weeds." *Annual Review of Entomology* 16: 159–178.

### **Books**

Andres, L.A., C.J. Davis, P. Harris, and A.J. Wapshere. 1976. "Biological control of weeds." In: *Theory and Practice of Biological Control*. New York: Academic Press, 481–499.

Charudattan, R. and H.L. Walker (eds). 1982. *Biological control of weeds with pathogens*. New York: John Wiley & Sons. 293 pp.

Coombs, E.M., Clark, J.K., Piper, G.L., and A.F. Cofrancesco, Jr. (eds). 2004. *Biological Control of Invasive Plants in the United States*. Oregon: Oregon State University Press. 448 pp.

Coulson, J.R. 1977. *Biological control of alligatorweed, 1959-1972: a review and evaluation*. USDA, Technical Bulletin 1547. 98 pp.

Coulson, J.R., P.V. Vail, M.E. Dix, D.A. Nordlund, and W.C. Kauffman (eds). *110 Years of biological control research and development in the United States Department of Agriculture*. In Press, U.S. Department of Agriculture.

DeLoach, C.; H.A. Cordo; and I.S. de Cruzel. 1989. *Control biológico de malezas*. El Ateneo, Buenos Aires. 266 pp.

Harley, K.L.S.; and I.W. Forno. 1992. *Biological Control of Weeds: A Handbook for Practitioners and Students*. Melbourne: Inkata Press. 27–36, 74 pp.

Kelleher, J.S., and M.A. Hulme (eds). 1984. *Biological control programmes against insects and weeds in Canada 1969-1980*. Commonwealth Agriculture. Bureaux 410 pages.

Mason, P.G., and J.T. Huber, 2002. *Biological Control Programmes in Canada, 1981-2000*. CABI Publishing.

Mulligan, G.A. (ed.). 1979. *The Biology of Canadian Weeds: Volume 1, Contributions 1-32*. Agriculture Canada, Ottawa, Ontario, Canada, Publication 1693. 380 pp.

Mulligan, G.A. (ed.). *The Biology of Canadian Weeds: Volume 2, Contributions* 33-61, Agriculture Canada, Ottawa, Ontario, Canada, Publication 1765, 415 pp.

TeBeest, D.O. (ed). 1991. *Microbial control of weeds*. Chapman and Hall. 284 pp.

Van Driesche, R.G.; Bellows, T.S., Jr. 1996. *Biology of weed control agents*. In: *Biological control*. New York, NY: Chapman & Hall. 539 pp.

Van Driesche, R., S. Lyon, B. Blossey, M. Hoddle, R. Reardon. 2002. *Biological Control of Invasive Plants in the Eastern United States*. USDA Forest Service. Forest Health Technology Enterprise Team Publication FHTET-2002-04. 413 pp.

Waterhouse, D.F. 1994. *Biological control of weeds: Southeast Asian prospects*. ACIAR. Canberra. 302 p.

### Websites

[“BCANZ-Biological Control Agents introduced to New Zealand,”](#) Ferguson, C.M., Moeed, A., Barrett, B.I.P., Hill, R.L., and Kean, J.M, Better Border Security New Zealand, 2007.

[“Best Practice Guide: Release and Establishment of Weed Biological Control Agents,”](#) CRC for Australian Weed Management, accessed March 4, 2014.

[“Biological Control: A Guide to Natural Enemies in North America-Weed Feeders,”](#) Cornell University, New York State Agricultural Experiment Station, Department of Entomology, Shelton, Anthony, accessed March 4, 2014.

[“Biological Control for Nature – Biological Control of Pests in Forests and Associated Habitats,”](#) University of California – Riverside, accessed June 17, 2013.

[“Biological Control of Pests in the Forests of Eastern United States,”](#) University of Massachusetts Amherst, 2009.

[“CABI current invasive species projects”](#), CABI, accessed June 17, 2013.

[“Control Mechanisms,”](#) USDA National Invasive Species Information Center, accessed June 17, 2013.

[“Idaho's BLM/ISDA Biological Control Program,”](#) State of Idaho – Agriculture, accessed March 4, 2014.

## References

### Biological Control of Weeds

---

“Invasive Plant Management: Control Methods – Biological Control,” Center for Invasive Species Management, accessed March 4, 2014.

“[Noxious Weeds Program Home Page](#),” United States Department of Agriculture, Animal and Plant Health Inspection Service, last modified January 20, 2023.

“[Plant Health \(PPQ\)](#),” United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, accessed June 17, 2013.

“[Technical Advisory Group for Biological Control Agents of Weeds](#),” United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, last modified April 28, 2021.

“The Weed’s News – biological control,” The Weed’s Network, accessed March 4, 2014.



## Economic Botany

### Books

Bailey, Liberty Hyde. 1949. *Manual of Cultivated Plants*. New York: Macmillan Publishing Company. 1116 pp.

Fernald, M.L. (ed). 1970. *Gray's Manual of Botany*. New York: D. Van Nostrand Co. 1632 pp.

Bailey, L.H., and Ethel Zoe Bailey. 1976. *HORTUS THIRD: a concise dictionary of plants cultivated in the United States and Canada*. New York: Macmillan Publishing Company. 1312 pp.

Howes, F.N. 1974. *A Dictionary of Useful and Everyday Plants and Their Common Names*. New York: Cambridge University Press. 294 pp.

Isaacson, R.T. (ed). 2000. *Andersen Horticultural Library's Source List of Plants and Seeds: a completely revised listing of 1996-2000 catalogues*. Chanhassen: The Library. 311 pp.

Uphof, J.C. 1968. *Dictionary of economic plants*. New York: Stechert-Hafner. 591 pp.

Whitson, T.D., L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, and R. Parker. 2009. *Weeds of the West*. 10th edition. Laramie: Western Society of Weed Science. 630 pp.

Wiersema, J.H., and B. Leon. 2013. *World Economic Plants: A Standard Reference*. 2nd Edition. CRC Press. 1336 pp.

### Websites

[“Interactive Ecological Atlas of Russia and Neighboring Countries: Economic Plants and Their Diseases, Pests and Weeds,”](#) Afonin, A.N., S.L. Greene, N.I. Dzyubenko, A.N. Frolov, USDA-ARS and St. Petersburg State University. 2008.

---

## Plant Taxonomy and Distribution

### Articles

APG III: Brigitta Bremer, K Kåre Bremer, Mark W. Chase, Michael F. Fay, James L. Reveal, Douglas E. Soltis, Pamela S. Soltis and Peter F. Stevens with contributions from Arne A. Anderberg, Michael J. Moore, Richard G. Olmstead, Paula J. Rudall, Kenneth J. Sytsma, David C. Tank, Kenneth Wurdack, Jenny Q.-Y. Xiang, and Sue Zmarzty. 2009. "An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III." *Botanical Journal of the Linnean Society*. 161: 105-121.

Cavers, P.B. (ed.). 1995. "The Biology of Canadian Weeds: Volume 3", Contributions 62-83. Agricultural Institute of Canada, Ottawa, Ontario, Canada, 338 pp.

Cavers, P.B. 2000. "The Biology of Canadian Weeds: Volume 4." Contributions 84-102, plus 3 updated contributions. Agricultural Institute of Ottawa, Ontario, Canada, 338 pp.

Cavers, P.B. 2005. The Biology of Canadian Weeds. Volume 5. Contributions 103-129, plus 3 updated contributions. Agricultural Institute of Ottawa, Ontario, Canada, 516 pp.

Mulligan, G.A. (ed). 1979. "The Biology of Canadian Weeds: Volume 1." Contributions 1-32. Agriculture Canada, Ottawa, Ontario, Canada, Publication 1693. 380 pp. (book?)

Mulligan, G.A. (ed). "The Biology of Canadian Weeds: Volume 2." Contributions 33-61, Agriculture Canada, Ottawa, Ontario, Canada, Publication 1765, 415 pp. (book?)

### Audiovisual Materials

Noxious and Nuisance Plant Management Information System (PMIS), U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS. (CD)

Purge S P U R G E: Leafy Spurge Database. Version 3.0. USDA, ARS in cooperation with Montana State University. Directed by Neal R. Spencer. (CD)

### Books

Bailey, L.H.; and Ethel Zoe Bailey. 1976. *HORTUS THIRD: a concise dictionary of plants cultivated in the United States and Canada*. New York: Macmillan Publishing Company. 1312 pp.

Brako, Lois, and Amy Y. Rossman, David F. Farr. 1995. *Scientific and Common Names of 7,000 Vascular Plants in the United States*. St. Paul: American Phytopathological Society. 301 pp.

Bremer, Kare. 1994. *ASTERACEAE: CLADISTICS AND CLASSIFICATION*. Portland: Timber Press. 752 pp.

Cronquist, Arthur. 1993. *The Evolution and Classification of Flowering Plants*. New York; The New York Botanical Garden. 556 pp.

Fernald, M.L. 1970. *Gray's Manual of Botany*. New York: D. Van Nostrand Company. 1632 pp.

Funk, V.A., T. Stuessy, and R. Bayer. 2009. *Systematics, Evolution, and Biogeography of Compositae*. Vienna: International Association for Plant Taxonomy. 965 pp.

Gunn, Charles., John Wiersema, J.H., Carole Ritchie, and Joseph Kirkbride, Jr. 1992. *Families and Genera of Spermatophytes Recognized by the Agricultural Research Service*. Washington, DC: USDA Technical Bulletin 1796. 500 pp.

Isaacson, Richard T. (ed). 2004. *Andersen Horticultural Library's Source List of Plants & Seeds*. Minnesota: University of Minnesota. 367 pp.

Kartesz, J.T. 1994. *A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland*. Portland: Timber Press, Inc. 1504 pp.

Mabberley, D.J. 2008. *Mabberley's Plant Book: A portable dictionary of plants, their classifications, and uses*. Third edition. Cambridge: Cambridge University Press. 1021 pp.

Terrell, Edward E. 1986. *A Checklist of names for 3,000 vascular plants of economic importance*. Washington, DC: U.S. Department of Agriculture, Agriculture Handbook No. 505.

Willis, J.C. (revised by H.K. Airy Shaw) 1988. *A dictionary of the flowering plants and ferns*. Cambridge: University Press. 1245 pp.

**Websites**

[“Annotated Checklist of the Panarctic Flora \(PAF\) Vascular Plants,”](#) Elven, R. (Editor-in-Chief), accessed July 17, 2013.

[“Endangered Species,”](#) U.S. Fish and Wildlife Service, accessed July 18, 2013.

[“Families and genera of spermatophytes recognized by the Agricultural Research Service,”](#) Gunn, C.R., Wiersema, J.H., Kirkbride, J.H. Jr., and Ritchie, C.A, United States Department of Agriculture, 1992, accessed July 17, 2013.

[“Flora Europae,”](#) Royal Botanic Garden Edinburgh, Inverleith Row, Edinburgh, EH3 5LR, United Kingdom, last modified January 2011.

[“Flora of North America,”](#) Flora of North America Association, last modified May 24, 2023.

[“The Global Plant Checklist Project,”](#) IOPI, International Organization for Plant Information, accessed July 17, 2013.

[“The information resource for Euro-Mediterranean plant diversity,”](#) Euro+Med PlantBase, accessed July 17, 2013.

[“Integrated Taxonomic Information System on-line database,”](#) ITIS, 2013.

[“The International Plant Names Index,”](#) The Royal Botanic Gardens, Kew, The Harvard University Herbaria, and The Australian National Herbarium, 2012.

[“The Jepson Online Interchange California Floristics,”](#) University of California, Berkeley, 2013.

[“National Wildlife Federation,”](#) National Wildlife Federation, Merrifield, Virginia, accessed July 17, 2013.

[“North American Vascula Flora,”](#) The Biota of North America Program (BONAP), 2013.

[“The PLANTS Database,”](#) USDA, NRCS, National Plant Data Team, Greensboro, North Carolina, USA, 2013.

[“The Plant List Version 1,”](#) Royal Botanic Gardens, Kew and Missouri Botanical Garden, 2010.

[“Purge Spurge: Leafy Spurge Database,”](#) NCSU, North Dakota State University, Fargo, North Dakota, accessed July 17, 2013.

“[The Tree of Life Web Project](#),” Maddison, D. R. and K.-S. Schulz (eds.), 2007.

“[Vascular Plant Family Nomenclature](#),” James L. Reveal, University of Maryland, College Park, November 27, 2004.

“[USDA-APHIS Concordance of Family Names](#),” James L. Reveal, The Department of Plant Biology at Cornell University, University of Maryland, College Park, and the New York Botanical Garden.

“[USDA-ARS Germplasm Resources Information Network \(GRIN\)](#),” USDA, ARS, National Genetic Resources Program, National Germplasm Resources Laboratory, Beltsville, Maryland, accessed July 17, 2013.

---

## Protected Species

### Websites

“[COSEWIC – Committee on the Status of Endangered Wildlife in Canada](#),” COSEWIC, accessed July 18, 2013.

“[Environmental Conservation Online System: Threatened and Endangered Species](#),” U.S. Fish and Wildlife Service, accessed July 2013.

“[List of Endangered and Threatened Species, including Candidate Species](#),” U.S. Fish and Wildlife Service, accessed March 4, 2014.

“[The National Wildlife Federation](#),” The National Wildlife Federation, accessed July 2013.

“[Native Plant Network](#),” USDA Forest Service and Southern Regional Extension Forestry, accessed July 2013.

“[The PLANTS Database](#),” USDA, NRCS, National Plant Data Team, Greensboro, North Carolina, USA, 2013.

“[Species at risk public registry](#),” Environment Canada, last modified July 4, 2023.

“[U.S. Fish and Wildlife Service](#),” U.S. Fish and Wildlife Service, accessed July 2013.

## Risk Assessment

### Articles

Anderson, M.C., M. Ewald, and J. Northcott. 2005. "Risk analysis and management decisions for weed biological control agents: Ecological theory and modeling results." *Biological Control* 35: 330-337.

Barratt, B.I.P. 2011. "Assessing safety of biological control introductions." *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition, and Natural Resources* 6 (42): 1-12.

Bourchier, R.S., and L.S. McCarty. 1995. "Risk assessment of biological control (predators and parasitoids)." *Bulletin of the Entomological Society of Canada* 27(3): 126-138.

Briese, D.T. 2004. "Weed biological control: Applying science to solve seemingly intractable problems." *Australian Journal of Entomology* 43: 304-317.

Carson, W.P., S.M. Hovick, A.J. Baumert, D.E. Bunker, and T.H. Pendergast, IV. 2008. "Evaluating the post-release efficacy of invasive plant biocontrol by insects: a comprehensive approach." *Arthropod-Plant Interactions* 2: 77-86.

Cook, R. James, William L. Bruckart, Jack R. Coulson, Mark S. Goettel, Richard A. Humber, Robert D. Lumsden, Joseph V. Maddox, Michael L. McManus, Larry Moore, Susan F. Meyer, Paul C. Quimby, Jr., James, P. Stack, and James L Vaughn. 1996. "COMMENTARY: Safety of Microorganisms Intended for Pest and Plant Disease Control: A Framework for Scientific Evaluation." *Biological Control* 7: 333-351.

Cullen, J.M. 1988. "Current problems in host-specificity screening." *Proceedings VII of the International Symposium of Biological Control of Weeds* 27-36.

Cullen, J.M. 1995. "Predicting effectiveness: fact and fantasy." *Proceedings of the VIII International Symposium of Biological Control of Weeds* Melbourne. DSIR/CSIRO.

Culliney, T.W. 2005. "Benefits of classical biological control for managing invasive plants." *Critical Reviews in Plant Sciences* 24: 131-150.

Delfosse, Ernest S. 2005. "Risk and ethics in biological control." *Biological Control* 35 (2005): 319-329.

Fowler, Simon.V., Pauline Styrett, and Richard L. Hill. 2000. “Success and safety in the biological control of environmental weeds in New Zealand.” *Austral Ecology* 25: 553-562.

Harris, Peter, and Peter McEvoy. 1995. “The predictability of insect host plant utilization from feeding tests and suggested improvements for screening weed biological control agents.” *Proceedings of the VIII International Symposium of Biological Control of Weeds* 125–131.

Hogarth, F.G. 1990. “Environmental impacts of classical biological control.” *Annual Review of Entomology* 36: 485-509.

[IPPC] International Plant Protection Convention. 2007. International Standards for Phytosanitary Measures No. 2: Framework for Pest Risk Analysis. Secretariat of the International Plant Protection Convention. FAO, Rome, 15 pp.

[IPPC] International Plant Protection Convention. 2005. International Standards for Phytosanitary Measures No. 3: Guidelines for the Export, Shipment, Import and Release of Biological Control Agents and Other Beneficial Organisms. Secretariat of the International Plant Protection Convention. FAO, Rome, 26 pp.

[IPPC] International Plant Protection Convention. 2004. International Standards for Phytosanitary Measures No. 11: Pest Risk Analysis for Quarantine Pests Including Analysis of Environmental Risks and Living Modified Organisms. Secretaria of the International Plant Protection Convention. FAO, Rome, 12 pp.

Louda, S.M., R.W. Pemberton, M.T. Johnson, and P.B. Follett. 2003. “Non-target effects—the Achilles’ heel of biological control? Retrospective analyses to reduce risk associated with biocontrol introductions.” *Annual Review of Entomology* 48: 365-396.

McCoy, Earl D., and J.H. Frank. 2010. “How should the risk associated with the introduction of biological control agents be estimated?” *Agricultural and Forest Entomology* 12: 1-8.

Pearson, D.E. and R.M. Callaway, 2005. “Indirect effects of host-specific biological control agents: Implications for biological control.” *Biological Control* 35: 288-298

Pemberton, P.D., and T.D. Center. 2012. “Biocontrol without borders: the unintended spread of introduced weed biological control agents.” *BioControl* 57: 319-319.



Pemberton, Robert W. 2000. "Predictable risk to native plants in weed biological control." *Oecologia* 125 (4): 489-494.

Raghu, S., K. Dhileepan and J.C. Scanlan. 2007. "Predicting risk and benefit a priori in biological control of invasive plant species: A systems modeling approach." *Ecological Modelling* 208 (2-4): 247-262.

Schwarzländer, M.; H.L. Hinz, and R. Wittenberg. 1996. "Oogenesis requirements and weed biocontrol: an essential part in host-range evaluation of insect agents or just wasted time?" *Proceedings of the IX International Symposium on Biological Control of Weeds*. Stellenbosch, South Africa: University of Cape Town. 79–85.

Sheppard, A.W., R.D. van Klinken, and T.A. Heard. 2005. "Scientific advances in the analysis of direct risks of weed biological control agents to nontarget plants." *Biological Control* 35: 215-226.

Sheppard, A.W., R.Hill, R.A. De Clerck-Floate, A. McClay, T. Olckers, P.C. Quimby Jr., and H.G. Zimmermann. 2003. "A global review of risk-benefit-cost analysis for the introduction of classical biological control agents against weeds: a crisis in the making?" *Biocontrol News and Information* 24(4): 91N-108N.

Simberloff, D., and P. Stiling. 1996. "Risks of Species introduced for biological control." *Biological Conservation* 78: 185-192.

Sing, Sharlene E., and Robert K.D. Peterson. 2011. "Assessing Environmental Risks for Established Invasive Weeds: Dalmation (*Linaria dalmatica*) and Yellow (*L. vulgaris*) Toadflax in North America." *International Journal of Environmental Research and Public Health* 8: 2828-2853

Van Klinken, R.D., and O.R. Edwards. 2002. "Is host specificity of weed biological control agents likely to evolve rapidly following establishment?" *ECOLOGY LETTERS* 5: 590-596.

Wright, Mark G., Michael P. Hoffman, Thomas P. Kuhar, Jeffery Gardner, and Sylvie A. Pitcher. 2005. "Evaluating risks of biological control introductions: A problemistic risk-assessment approach." *Biological Control* 35: 338-347.

### Books

Follett, P.A., and J.J. Duan (eds.) 2000. *Nontarget Effects of Biological Control*. Kluwer Academic Publishers. 316 pp.

Lonsdale, W.M., D.T. Briese, and J.M. Cullen. 2001. "Risk analysis and weed biocontrol." *Evaluating Indirect Effects of Biological Control*. Wallingford, UK: CABI Publishing 185-210.

NRC National Research Council. 1983. *Risk Assessment in the Federal Government: Understanding the Process*. National Academy Press: Washington, D.C. 192 pp.

U.S. EPA. "Guidelines for Ecological Risk Assessment." U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC. EPA/630/R095/002F, 1998.

### Websites

["Decision Support Tools,"](#) USDA National Invasive Species Information System, accessed March 21, 2014.

["Guidelines for Ecological Risk Assessment,"](#) U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, EPA/630/R095/002F, 1998.

["Noxious Weeds Program Risk Assessments,"](#) United States Department of Agriculture, Animal and Plant Health Inspection Service, last modified April 6, 2021.

["Review of the National \(Australian\) Weed Risk Assessment System,"](#) National (Australian) Weed Risk Assessment System Review Group, August 2, 2006.

## Testing Methodology for Biological Control

### Articles

Barton, J. 2004. "How good are we at predicting the field host-range of fungal pathogens used for classical biological control of weeds?" *Biological Control* 31: 99-122.

Barton, J. 2012. "Predictability of pathogen host range in classical biological control of weeds: an update." *Biocontrol* 57: 289-305.

Berner, D. K. & Cavin, C.A. 2011. "Finalizing host range determination of a weed biological control pathogen with best linear unbiased predictors and damage assessment." *BioControl* 57: 235-246.

Briese, D.T. 1996. "Phylogeny: can it help us to understand host choice by biological weed control agents?" *Proceedings of the IX International Symposium on Biological Control of Weeds, Stellenbosch, South Africa* 63-70.

Briese, D.T. 2005. "Translating host-specificity test results into the real world: The need to harmonize the yin and yang of current testing procedures." *Biological Control*. 35: 208-214.

Briese, D.T. and A. Walker. 2008. "Choosing the right plants to test: The host-specificity of *Longitarsus* sp. (Coleoptera: Chrysomelidae) a potential biological control agent of *Heliotropium amplexicaule*." *Biological Control* 44: 271-285.

Charudattan, R. 2005. "Ecological, practical, and political inputs into selection of weed targets: What makes a good biological control target?" *Biological Control* 35: 183-196.

Clement, S. L. and M. Cristofaro. 1995. "Open-field tests in host specificity determination of insects for biological control of weeds." *Biocontrol Science and Technology* 5: 395-406.

Cook, R.J., W.L. Bruckart, J.R. Coulson, M.S. Goettel, R.A. Humber, R.D. Lumsden, J.V. Maddox, M.L. McManus, L. Moore, S.F. Meyer, et. al. 1996. "Safety of microorganisms intended for pest and plant disease control: A framework for scientific evaluation." *Biological Control* 7(3): 333-351.

Cullen, J.M. 1988. "Current problems in host-specificity screening." *Proceedings VII of the International Symposium of Biological Control of Weeds* 27-36.

## References

Davis, A.S., D.A. Landis, V. Nuzzo, B. Blossey, E. Gerber, and H. L. Hinz. 2006. "Demographic Models Inform Selection of Biocontrol Agents for Garlic Mustard (*Alliaria petiolata*)." *Ecological Applications* 16(6): 2399-2410.

Drea, John J., Jr. 1991. "The philosophy, procedures, and cost of developing a classical biological control of weeds project." *Natural Areas Journal* 11(3): 143-147.

Dunn, P.H. 1976. "Shortcomings in classic tests of candidate insects for the biocontrol weeds." *Proceedings of the IV International Symposium on Biological Control of Weeds; Gainesville, FL* 51-56.

Fowler, S.V., Q. Panter, S. Dodd, and R. Groenteman. 2012. "How can ecologists help practitioners minimize non-target effects in weed biocontrol?" *Journal of Applied Ecology* 49: 307-310.

Gaskin, John F., Mare-Claude. Bon, Matthew J.W. Cock, Massimo Cristofaro, Alessio De Biase, Rose De Clerck-Floate, Carol A. Ellison, Harriet L. Hinz, Ruth A. Hufbauer, Mic H. Julien, and René Sforza. 2011. "Applying molecular-based approaches to classical biological control of weeds." *Biological Control* 58: 1-21.

Goolsby, J.A., R.D. van Klinken, and W.A. Palmer. 2006. "Maximising the contribution of native-range studies towards the identification and prioritisation of weed biocontrol agents." *Australian Journal of Entomology* 45(4): 276-286.

Hasan, S., E.S. Delfosse, E. Aracil, and R.C. Lewis. 1992. "Host-specificity of *Uromyces heliotropii*, a fungal agent for the biological control of common heliotrop (*Heliotropium europaeum*) in Australia." *Annals of Applied Biology* 121: 697-705.

Marohasy, J. 1998. "The design and interpretation of host-specificity tests for weed biological control with particular reference to insect behaviour." *Biocontrol News and Information* 19(1): 13N-20N.

McClay, A.S., and J.K. Balciunas. 2005. The role of pre-release efficacy assessment in selecting classical biological control agents for weeds-applying the Anna Karenina principle." *Biological Control* 35: 197-207.

McEvoy, P.B. 1996. "Host specificity and biological pest control." *Bioscience* 46: 401-405.

McEvoy, P.B., and E.M. Coombs. 1999. "Biological control of plant invaders: regional patterns, field experiments, and structured population models." *Ecological Applications* 9: 387-4019.

Morin, L., K.J. Evans, and A.W. Sheppard. 2006. "Selection of pathogen agents in weed biological control: critical issues and peculiarities in relation to arthropod agents." *Australian Journal of Entomology* 45: 349-365.

Pratt, P.D., M.B. Rayamajhi, T.D. Center, P.W. Tipping, and G.S. Wheeler. 2009. "The ecological host range of an intentionally introduced herbivore: a comparison of predicted versus actual host use." *Biological Control* 49: 46-153.

Raghu, S., and K. Dhileepan. 2005. "The value of simulating herbivory in selecting effective weed biological control agents." *Biological Control* 34: 265-273.

Raghu, S., and R.D. van Klinken (eds). 2006. "Refining the ecological basis for agent selection in weed biological control." *Australian Journal of Entomology* 45(4): 251-372.

Raghu, S., J.R. Wilson, and K. Dhileepan. 2006. "Refining the process of agent selection through understanding plant demography and plant response to herbivory." *Australian Journal of Entomology* 45: 308-316.

Rector, B.G. 2008. "Molecular biology approaches to control of intractable weeds: New strategies and complements to existing biological practices." *Plant Science* 175: 437-448.

Schwarzländer, M., H.L. Hinz, and R. Wittenberg. 1996. "Oogenesis requirements and weed biological control: an essential part in host-range evaluation of insect agents or just wasted time?" *Proceedings of the IX International Symposium on Biological Control of Weeds*. Stellenbosch, South Africa: University of Cape Town. 79-85.

Van Klinken, R.D. and S. Raghu. 2006. "A scientific approach to agent selection." *Australian Journal of Entomology* 45: 253-258.

Wapshere, A.J. 1974. "A strategy for evaluating the safety of organisms for biological weed control." *Annals of Applied Biology* 77(2): 201-211.

Withers, Toni M. 2003. "Examining the hierarchy threshold model in a no-choice feeding assay." *Entomologia Experimentalis et Applicata* 91: 89-95.

## References

Testing Methodology for Biological Control

---

### Books

Harley, K.L.S., and I.W. Forno. 1992. "Biology and Host-specificity of Biological Control Agents." 27–36. In: *Biological Control of Weeds: A Handbook for Practitioners and Students*. Melbourne: Inkata Press. 74 pp.

Van Driesche, R., T. Heard, A. McClay and R. Reardon. 2000. *Host Specificity Testing of Exotic Arthropod Biological Control Agents - The Biological Basis for Improvement in Safety*. USDA Forest Service. Forest Health Technology Enterprise Team Publication FHTET-99-1. 95 pp.

### Websites

["BIREA - Biocontrol Information Resource for ERMA New Zealand Applicants,"](#) Barratt B.I.P., Berndt L.A., Dodd S.L., Ferguson C.M., Hill R.L., Kean J.M., Teulon D.A.J. and Withers T.M., 2007.

"Steps in a weed biological control program," CSIRO, last modified October 2011.

# Glossary

---

## Introduction

Use this glossary to find the meaning of specialized abbreviations, acronyms, terms, and words used in this manual. To locate where in the manual a given abbreviation, acronym, or term is mentioned, refer to the index.

---

## Definitions, Terms, and Abbreviations

**abiotic.** Not pertaining to life or specific life conditions.

**APHIS.** Animal and Plant Health Inspection Service, USDA.

**ARS.** Agricultural Research Service, USDA.

**BCDC.** Biological Control Documentation Center.

**BIA.** Bureau of Indian Affairs, USDI.

**biological assessment (BA).** Under the Endangered Species Act, the evaluation of a proposed action's potential effects on listed and proposed species and designated/proposed critical habitat.

**biological control agent.** A natural enemy, antagonist, or competitor, or other organism, used for pest control (FAO Glossary, 2010; ISPM 3:1995; revised ISPM 3:2005).

**biological evaluation (BE).** A generic term for all other types of analyses (**other than** a biological assessment). If a listed species or critical habitat is likely to be affected, then the Agency **must** provide the Services (USFWS and NMFS) with an evaluation on the likely effects of the action. Often this information is referred to as the BE.

**biological control agents.** Organisms that suppress or kill weedy plants without significantly injuring desirable plants (Andres, 1977).

**biotype.** A group of organisms having the same genotype, but varying characteristics (e.g., strain differences or different physiological characteristics). The organisms sharing a specified genotype; also: the genotype shared or its distinguishing peculiarity. ([www.merriam-webster.com/dictionary](http://www.merriam-webster.com/dictionary)).

**BLM.** Bureau of Land Management, USDI.

**BR.** Bureau of Reclamation, USDI.

**CBP.** Customs and Border Protection

**CFR.** Code of Federal Regulations

**COE.** Army Corps of Engineers.

**conference.** A process which involves informal discussions between a Federal Agency and the FWS/NMFS under Section 7(a)(4) of the Act (ESA) regarding the impact of an action on proposed species or proposed critical habitat and recommendations to minimize or avoid the adverse effects.

**confinement (of a regulated article).** Application of official measures for regulated articles to prevent escape. [CPM, 2012]

**containment.** Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 1995)

**containment facility.** Laboratory, greenhouse, or other type of secure installation designed to effectively prevent the escape or entry of organisms. (NAPPO 2012; RSPM 7: 2008; RSPM 12:2008; RSPM 22: 2011; RSPM 27: 2007; RSPM 29: 2008)

**control (of a pest).** Suppression, containment, or eradication of a pest population. [FAO, 1995]

**cryptic or sibling species.** Sexually isolated populations with few or **no** tangible recognition characters to set them apart from the general species populations.

**CSREES.** See NIFA.

**diapause.** Period of arrested morphological development or suspended animation.

**DOD.** Department of Defense.

**EA. environmental assessment.** A concise, public document that briefly provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a finding of **no** significant impact (FONSI).

**ecosystem.** A dynamic complex of plant, animal and micro-organism communities and their abiotic environment interacting as a functional unit. [ISPM 3:1995; revised ICPM, 2001]

**edaphic.** Of or pertaining to soil, especially as it affects living organisms.



**EIS.** Environmental Impact Statement. Serves as a broad, comprehensive reference evaluating anticipated environmental effects of alternative planned causes of action. APHIS prepares an EIS to meet its National Environmental Policy Act (NEPA) responsibilities.

**environmental impact.** Effects on the agriculture, human health, and the environment.

**EPA.** Environmental Protection Agency.

**ESA.** Endangered Species Act. ESA as amended, was established in 1973 providing the policies and procedures for protecting endangered and threatened species of fish, wildlife, and plants. An objective of ESA is to provide ways to conserve endangered and threatened species and their habitats. Also, ESA requires APHIS to consult with the U.S. Fish and Wildlife Service (FWS) to ensure that any anticipated program or action is **not** likely to jeopardize the survival of listed species, or is **not** likely to adversely modify or destroy their critical habitat.

**exotic species.** Alien in origin, to the specific ecosystem under consideration.

**FACA.** Federal Advisory Committee Act. TAG-BCAW meetings shall be conducted in compliance with the Federal Advisory Committee Act (FACA).

**FONSI. Finding of no Significant Impact.** A public document that presents the reasons a proposed action would **not** have a significant impact on the environment, based on the results of an EA.

**FS.** Forest Service, USDA.

**FWS.** Fish and Wildlife Service, USDI.

**habitat.** Part of an ecosystem with conditions in which an organism naturally occurs or can establish. [ICPM, 2005]

**host range.** Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO, 1990; revised ISPM 3:2005).

**host specificity testing.** The process by which the species of plants at risk from a biological control agent in the field is determined. (NAPPO Glossary, 1999)

**incidence (of a pest).** Proportion or number of units in which a pest is present in a sample, consignment, field, or other defined population. [CPM, 2009]

**infestation (of a commodity).** Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection [CEPM 1997; revised CEPM, 1999]

**IPPC.** International Plant Protection Convention as deposited with FAO in Rome in 1951 and as subsequently amended. [FAO, 1990]

**ISPM.** International Standard for Phytosanitary Measures [CEPM, 1996; revised. ICPM, 2001]

**isolates.** Limited taxonomic collections of pathogens made from a specific location, and thus may **not** represent the entire genetic base of the species.

**material.** Includes living organisms and toxins.

**monitoring.** An official ongoing process to verify phytosanitary situations. [CEPM, 1996]

**morphometric.** Relating to measurement of external form.

**NAPPO.** North American Plant Protection Organization. International organization consisting of representatives from Canada, Mexico, and the United States.

**NEPA.** National Environmental Policy Act. Congress enacted NEPA in 1969 to ensure that Federal agencies assess the impact of potential environmental consequences before undertaking major programs or projects. Detailed information on the NEPA process is contained in “Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act,” 40 CFR Parts 1500–1508.

**NIFA.** National Institute of Food and Agriculture. Formerly CSREES (Cooperative State Research, Education, and Extension Service.)

**NPS.** National Park Service, USDI.

**NMFS.** National Marine Fisheries Service.

**NRCS.** Natural Resources Conservation Service, USDA.

**natural enemy.** An organism which lives at the expense of another organism in its area of origin and which may help to limit the population of that organism. This includes parasitoids, parasites, predators, phytophagous organisms, and pathogens. [ISPM 3:1995; revised ISPM 3:2005]

**official.** Established, authorized, or performed by a national plant protection organization. [FAO, 1990]

**organism.** Any biotic entity capable of reproduction or replication in its naturally occurring state. [ISPM 3:1995; revised ISPM 3:2005]

**parasite.** An organism which lives on or in a larger organism, feeding upon it. [ISPM 3:1995]

**parasitoid.** An insect parasitic **only** in its immature stages, killing its host in the process of development, and free living as an adult [ISPM 3:1995]

**pathogen.** Micro-organism causing disease [ISPM 3:1995]

**pest.** Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products. Note: In the IPPC, plant pest is sometimes used for the term pest [FAO, 1990; revised FAO 1995; IPPC, 1997; revised CPM, 2012]

**petition.** A formal, written application to a regulatory Agency seeking approval to release an exotic biological control agent. [NAPPO Glossary, 1999]

**phytophagous.** Organisms that eat plants.

**planting.** Any operation for the placing of plants in a growing medium, or by grafting or similar operations, to ensure their subsequent growth, reproduction, or propagation. [FAO, 1990; revised CEPM, 1999]

**plants.** Living plants.

**polyphagous.** Feeding on or utilizing a variety of plants.

**positive control.** Where the target is present at every step in the test process (i.e., treatment in which you would expect a positive response).

**PPD.** Policy and Program Development.

**PPQ.** Plant Protection and Quarantine.

**quarantine.** Official confinement of regulated articles for observation and research or for further inspection, testing or treatment. [FAO 1990; revised FAO, 1995; CEPM 1999]

**release.** (into the environment) Intentional liberation of an organism into the environment. [ISPM 3:1995]

**replicate .** Replication of an experimental condition so that the variability associated with the phenomenon can be estimated.

**reference specimen.** Specimen, from a population of a specific organism, observed and accessible for the purpose of identification, verification, or comparison. [ISPM 3:2005; revised CPM 2009]

**seeds.** A commodity class for seeds for planting or intended for planting and **not** for consumption or processing. [FAO, 1990; revised ICPM, 2001]

## Glossary

### Definitions, Terms, and Abbreviations

---

**suppression.** The application of phytosanitary measures in an infested area to reduce pest populations [FAO, 1995; revised CEPM, 1999]

**spread.** (of a pest) Expansion of the geographical distribution of a pest within an area [FAO, 1995]

**standard operation procedure (SOP).** . Codified best laboratory practices for handling biological control agents in quarantine or containment. (NAPPO 2012: NAPPO Glossary, 1999)

**SPRO.** State Plant Regulatory Official. Contact information for these officials can be found on the [National Plant Board Web site](#). There is also a list of these officials in the *Postentry Quarantine Manual*.

**survey.** An official procedure conducted over a defined period of time to determine the characteristics of a pest population or to determine which species occur in an area. [FAO, 1990; revised CEPM, 1996]

**take.** To harm, harass, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any of these activities.

**test.** Official examination, **other than** visual, to determine if pests are present or to identify pests. [FAO, 1990]

**test plant list.** A representative list of plant species that will be subjected to host specificity tests. (Drea, 1991, p. 144)

**USDA.** United States Department of Agriculture.

**USDC.** United States Department of Commerce.

**USDI.** United States Department of the Interior.

**USGS.** United States Geological Survey, USDI.

**voucher specimens.** A series of individuals from a specific population deposited in the National Collection(s) of the country. (NAPPO 2012; RSPM 19: 2012; RSPM 27:2007).

# Index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

## Numerics

16 U.S.C. 1451 et. seq. 1-1-3  
16 U.S.C. 1531 1-1-3, 3-2-2  
42 U.S.C. 4321 1-1-3, 3-2-2  
50 CFR §402.08 6-1-3  
50 CFR §402.14 6-1-4  
50 CFR 402.13 6-1-3  
50 CFR Part 402 6-1-1  
64 CFR 6184 1-1-3  
64 FR 6183 3-2-2  
7 CFR 330.200 2-1-3, 3-2-3  
7 CFR 330.201 through 330.203 3-2-5  
7 U.S.C. 7701 1-1-3, 1-1-4

## A

additional comments  
    cover letter for 5-4-3  
    TAG-BCAW members sending for 5-2-2  
    TAG-BCAW members sending test plant lists  
    for 5-4-3

## addresses

PPQ Manuals Unit 1-1-9  
TAG-BCAW Executive Secretary 5-2-17, 5-4-  
17, B-1-4  
TAG-BCAW membership A-1-1  
U.S. FWS Regional Offices D-1-1—D-1-2

## advice 2-1-3, 3-2-2

Agricultural Research Service (ARS) 1-1-4  
    perspective 2-3-3  
    TAG-BCAW member A-1-1  
    TAG-BCAW membership 2-2-5  
    taxonomic institution F-1-8  
    Technical Bulletin 1616 F-1-6

## Agriculture and Agri-Food Canada (AAFC)

biological control of weeds 2-1-1  
cooperating 1-1-4  
perspective 2-3-10  
TAG-BCAW member A-1-2  
taxonomic institution F-1-8

## analysis

biological control agents of weeds 4-1-3  
DNA 5-1-9  
experimental methodology and 5-1-11  
mixed model 4-4-3  
NEPA 2-1-3—2-1-4

## Animal and Plant Health Inspection Service (APHIS) 1-1-4

TAG-BCAW membership 2-2-5

## annual meetings

TAG-BCAW 2-2-4  
TAG-BCAW Executive Secretary duties 2-2-3

## APHIS

Section 7 requirements 6-1-2

APHIS Form 2000 B-1-10

APHIS regulations 3-2-5

## APHIS-PPQ

determination with USFWS or NMFS  
    consultation 3-2-6

    recommendations from TAG-BCAW to 2-1-3

APHIS-PPQ Pest Permitting Branch 2-3-2, 3-2-2,  
B-1-12

## approaches

Agricultural Research Service (ARS) 2-3-3  
evaluation checklist 5-2-13  
identification and characterization 4-2-4  
research use 5-2-4  
taxonomic 4-2-4

## approval process

National Plant Board 2-3-9

## Army Corps of Engineers (COE) 2-3-9

perspective 2-3-9  
TAG-BCAW Chair A-1-2  
TAG-BCAW history 2-1-2  
TAG-BCAW membership 2-2-5  
TAG-BCAW review 2-4-2

## arthropods

field testing 4-3-7  
oviposition testing 4-3-6

## assessing risk 2-1-4

## B

## biological assessment (BA)

designation of non-Federal representative 6-  
1-3

document 6-2-1

elements of 3-2-7

guidelines 6-2-1

information to include 6-2-2

may affect, likely to adversely affect  
    determination 6-2-5

prepared by APHIS 3-2-7

purpose 6-2-1

Section 7 consultation requirement 3-2-7

USFWS review 3-2-7

## biological control 2-1-1, 2-3-2

Agricultural Research Service (ARS) 2-3-3

APHIS authority 3-2-1

APHIS-PPQ-CPHST 2-3-2

Army Corps of Engineers (COE) 2-3-9

Bureau of Indian Affairs 2-3-5

Bureau of Land Management (BLM) 2-3-5

Bureau of Reclamation (BR) 2-3-6

Environmental Protection Agency (EPA) 2-3-9

Fish and Wildlife Service (FWS) 2-3-7

Forest Service (FS) 2-3-3

Mexico 2-3-10

- National Park Service (NPS) 2-3-7
- National Plant Board 2-3-9
- practice of 4-1-1
- reference collections 4-2-8
- weed management option 4-1-2
- Weed Science Society of America 2-3-9
- Biological Control Agent Release Proposal (BCARP) 2-3-6
- biological control agents
  - authority to regulate importation and release 2-1-3
  - permit for removal from containment 3-2-6
  - Plant Protection Act 1-1-3
  - proposed environmental release and consultation with Tribal Governments 3-2-8
  - risk analysis 4-1-3
- biological control organisms 2-3-2, 3-2-3
- Biological Control Release Record 2-3-6
- biological evaluation (BE) 6-2-1
- biologically relevant phenological stages 4-3-4
- biotypes 4-2-4, 4-4-3
- Bureau of Indian Affairs (BIA)
  - cooperating agency 1-1-4
  - perspective 2-3-5
  - TAG-BCAW member A-1-1
  - TAG-BCAW membership 2-2-5
- Bureau of Land Management (BLM) 1-1-4
  - cooperating 1-1-4
  - perspective 2-3-5
  - Subcommittee on Biological Control of Weeds 2-1-2
  - TAG-BCAW membership 2-2-5
- Bureau of Reclamation (BR)
  - cooperating agency 1-1-4
  - perspective 2-3-6
  - Subcommittee on Biological Control of Weeds 2-1-2
  - TAG-BCAW member A-1-3
  - TAG-BCAW membership 2-2-6
- C**
- Canada 5-1-3
  - Agriculture and Agri-Food Canada 1-1-4, 2-3-10
  - historical informal review 2-1-2
  - NAPPO Standard C-1-1
  - national specimen collections 4-2-8
  - TAG-BCAW contact A-1-2
  - taxonomic institutions in F-1-8
  - Web site for Committee on the Status of Endangered Wildlife in Canada F-1-20
- candidate species
  - threatened and endangered species 3-2-2
- characterization 4-2-1, 5-2-4
- charter 2-2-1
- classical biological control 2-1-1
- classification system 5-4-4
- classification systems 5-3-9, 5-4-3
- Coastal Zone Management Act 1-1-3
- comments 2-2-2, 2-2-6, 2-4-1, 3-2-2, 3-2-5, 3-2-8, 5-2-2, 5-2-3, 5-2-8, 5-2-17, 5-3-3, 5-4-2, 5-4-3, 5-4-17, 6-1-6, B-1-7
- compliance
  - ESA Section 7 3-2-6
- concurrency letter
  - may affect, not likely to adversely affect 3-2-7
- conflicts of interest 2-1-4
- consultation
  - no effect on listed species or critical habitat 3-2-6
- Consultation and Coordination with Indian Tribal Governments, EO 13175 3-2-8
- containment facilities
  - inspection of 3-2-3
  - live biological control organisms 3-2-3
- continued curation
  - PPQ 526 Permit for 3-2-4
- continued movement
  - colonies or cultures of organisms 3-2-4
- controls 4-4-7
- critical habitat
  - proposed release no effect on designated 3-2-6
- cryptic species 4-2-6, 5-1-8, 5-1-13, 5-2-11, 5-2-14
- D**
- diapause 4-2-5, 5-1-9
- directories
  - Conservation Directory 5-3-8
  - TAG-BCAW Membership Directory A-1-1
  - U.S. Fish and Wildlife Service (FWS) Regional Offices D-1-1
- Directory of TAG Membership A-1-1
- disease 4-4-3
- diseases 4-4-1, 4-4-2, 4-4-3
  - soil and susceptibility to 4-4-4
  - symptomatology 4-4-5
  - techniques for rating 4-4-4
- District of Columbia
  - interstate movement of live biological control organisms 3-2-3
- documentation flow 3-1-1
- duties
  - TAG-BCAW Chair 2-2-3
  - TAG-BCAW Executive Secretary 2-2-3
  - TAG-BCAW members 2-2-2
  - USDA-APHIS-PPQ 2-2-4
- E**
- early involvement 2-1-3
- ecologically relevant phenological stages 4-3-4
- economic impacts 2-3-2
- ecosystems
  - safeguarding 2-3-2
- endangered species
  - Mexico 2-3-10
- Endangered Species Act (ESA)
  - affect release 3-2-2
  - compliance 3-2-6, 6-2-1
  - FWS perspective 2-3-7
  - purpose 6-1-1
  - regulatory authority 1-1-3
  - Section 7 6-1-2
  - TAG-BCAW mission consideration of 2-2-1

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

- TAG-BCAW Section 7 compliance with [6-1-6](#)  
 Environment Protection Agency (EPA)  
 perspective [2-3-9](#)  
 environmental assessment (EA) [3-2-7](#)  
 element of biological assessment (BA) [3-2-7](#)  
 for NEPA compliance [3-2-7](#)  
 potential environmental impacts [5-1-15](#)  
 environmental compliance [3-2-8](#)  
 environmental impact statement (EIS) [3-2-7](#), [3-2-8](#),  
[6-2-1](#)  
 environmental impacts [5-1-13](#), [5-1-15](#)  
 aim to minimize [2-3-2](#)  
 comment sheet review [2-4-2](#)  
 Compliance with NEPA [3-2-7](#)  
 petition evaluation checklist [5-2-16](#)  
 Environmental Protection Agency (EPA)  
 TAG-BCAW membership [2-2-5](#)  
 EO 13175, Consultation and Coordination with Indi-  
 an Tribal Governments [3-2-8](#)  
 EPA-Office of Pesticide Programs [A-1-3](#)  
 evaluation checklist  
 field release of biological control agents of  
 weeds [5-2-5](#)  
 Executive Order 13112 [1-1-3](#)
- F**  
 facilitator TAG-BCAW [2-1-3](#)  
 Federal  
 lists of threatened and endangered species [3-2-2](#)  
 Federal action Agency  
 designation of non-Federal representative [6-1-3](#)  
*Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations* [3-2-2](#)  
 Federal Advisory Committee Act (FACA) [2-1-3](#), [2-2-5](#)  
 Federal Agencies  
 ESA Section 7 requirements [6-1-2](#)  
 Federal Insecticide, Fungicide, and Rodenticide Act [2-3-6](#)  
 field cages  
 testing candidate agents [4-3-4](#)  
 field-collected material [4-3-3](#)  
 final decisions [2-1-4](#)  
 Finding of No Significant Impact (FONSI) [3-2-7](#)  
 Fish and Wildlife Service (FWS) [1-1-4](#)  
 Fish and Wildlife Service (USFWS)  
 contacting for guidance [3-2-2](#)  
 Food Quality Protection Act of 1996 [2-3-6](#)  
 Forest Service  
 TAG-BCAW membership [2-2-5](#)  
 Forest Service (FS) [1-1-4](#)  
 TAG-BCAW member [A-1-1](#)  
 formal consultation  
 APHIS with USFWS [3-2-7](#)  
 functional analysis [4-2-5](#)
- G**  
 genetically-engineered plant pests [B-1-10](#)  
 genetically-engineered plants [B-1-10](#)
- H**  
 host specificity testing  
 advice [2-1-3](#)  
 proposed plant list [2-2-2](#)  
 host testing phase  
 contacting USFWS [3-2-2](#)
- I**  
 identifying biological control agents [4-2-5](#)  
 Importation  
 live biological control organisms into U.S. and  
 Territories [3-2-3](#)  
 importation  
 biological control agent authority [2-1-3](#)  
 regulated by APHIS [2-1-1](#)  
 informal consultation [3-2-6](#), [6-1-3](#)  
 Interagency Cooperation [6-1-2](#)  
 interagency cooperation [6-1-1](#)  
 interstate movement  
 live biological control organisms [3-2-3](#)  
 invasive species  
 executive order [1-1-3](#)
- L**  
 laboratory colonies [4-3-2](#), [4-3-3](#)  
 live biological control organisms  
 permits [3-2-3](#)  
 live regulated organisms  
 in containment beyond expiration of 526  
 permit [3-2-4](#)
- M**  
 may affect and is likely to adversely affect  
 formal consultation requirement [3-2-7](#)  
 Memorandum of Understanding (MOU) [2-3-6](#)  
 Mexico [2-2-5](#), [4-2-8](#)  
 cover page [5-1-3](#)  
 NAPPO Standard [C-1-1](#)  
 national collections [4-2-8](#)  
 SAGARPA-SENASIA-DGSV [1-1-4](#)  
 TAG-BCAW [2-2-3](#)  
 TAG-BCAW directory [A-1-3](#)  
 taxonomic institution [F-1-8](#)  
 movement  
 live biological control organisms from  
 containment facilities [3-2-3](#)  
 multiple choice tests [4-3-4](#)
- N**  
 NAPPO RSPM No. 7 [4-2-8](#)  
 national collection required deposit [4-2-8](#)  
 national collections [4-2-8](#), [4-2-9](#)  
 National Environmental Policy Act (NEPA)  
 compliance [3-2-6](#)  
 environmental assessment (EA) [3-2-7](#)  
 regulatory authority [1-1-3](#)  
 National Environmental Policy Act (NEPA) analysis  
[2-1-3](#)  
 National Institute of Food and Agriculture (NIFA) [1-1-4](#)  
 TAG-BCAW membership [2-2-5](#)  
 National Marine Fisheries Service (NMFS)  
 consultation [3-2-6](#)  
 National Park Service (NPS) [1-1-4](#)  
 TAG-BCAW membership [2-2-6](#)  
 National Plant Board  
 perspective [2-3-9](#)

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z



- TAG-BCAW cooperating organization 1-1-4
- TAG-BCAW member A-1-2
- TAG-BCAW membership 2-2-6
- Native American Tribes
  - release of proposed biological control agents of weeds 3-2-8
- Native Americans 2-3-5
- Natural Resource Conservation Service 1-1-4
  - TAG-BCAW membership 2-2-5
- NEPA analysis 2-1-4
- no-choice tests 4-3-4
- non-active TAG-BCAW members 2-2-6
- nonindigenous biological control agents 2-2-1
  - contacting TAG-BCAW early 2-2-2
- nonindigenous organisms 2-2-2
  - APHIS permitting process 3-2-1
- nonindigenous pests 2-3-2
- nonindigenous species
  - US FWS perspective 2-3-7
- nonindigenous weed biological control organisms
  - permit issuance for 3-2-6
- non-indigenous weeds 2-3-2
- O**
  - open field tests 4-3-4
  - oviposition testing 4-3-6
  - oviposition tests 4-3-7
- P**
  - permit expiration
    - live biological control organisms in containment facilities 3-2-3
  - permits
    - requirements for APHIS 3-2-3
  - Pest Permitting Branch 2-3-2, 3-2-2, B-1-12
  - petitioners
    - action recommendation prior to permit application 2-1-4
    - APHIS permitting process 3-2-2
    - application for 526 permit to remove biological control organism from containment 3-2-6
    - contacting USWFS 3-2-2
    - ESA Section 7 process participation 6-1-2
    - receipt of APHIS letter support release 3-2-6
  - petitions
    - first-time field release 2-2-2
  - petitions for release
    - review and evaluation of submitted 2-3-1
  - plant classification system E-1-1
  - plant diseases 2-3-2
  - Plant Protection Act of 2000 (PPA)
    - regulatory authority 1-1-3
  - potential petitioners 2-1-3
  - PPQ 526 Permit
    - continued curation 3-2-4
    - for importation of live biological control organisms 3-2-3
    - for removal from containment 3-2-4
    - renewal for continued movement interstate movement renewal 3-2-4
  - PPQ 526 permit
    - retention of regulated organisms in containment 3-2-4
- PPQ 526 permits
  - guidance and instructions for obtaining 3-2-3
- proposed biological control agents
  - final testing 4-3-4
- proposed biological control agents of weeds
  - TAG-BCAW recommendations 2-1-4
- proposed environmental release
  - weed biological control agents 3-2-8
- proposed plant list
  - test plant list for host specificity testing 2-2-2
- proposed test plant list 3-2-2
- R**
  - recommendations
    - TAG-BCAW 2-1-4
    - TAG-BCAW to APHIS 2-1-3
  - reference collection
    - individuals from released population 4-2-8
  - regulatory agencies 2-1-4
  - release
    - biological control agents 2-1-4
    - biological control agents authority 2-1-3
    - biological control agents into environment. 3-2-6
    - non-indigenous biological control agent 2-2-2
    - regulated by APHIS 2-1-1
  - research community 2-1-4
  - researchers
    - early involvement of TAG-BCAW 2-1-3
    - input from USFWS or NMFS 3-2-6
  - retention
    - containment beyond 526 permit expiration 3-2-4
    - live biological control organisms in containment facilities 3-2-3
  - review process 3-2-2
  - risk analysis
    - biological control agents 4-1-3
- S**
  - safeguarding American agriculture 2-3-2
  - SAGARPA-SENASIA-DGSV 1-1-4
    - perspective Mexico 2-3-10
  - science-based link 2-1-4
  - screening tests
    - test plant list species 4-3-4
  - Section 7 6-1-1, 6-1-2
    - biological assessment (BA)
      - prepared by APHIS 3-2-7
  - species
    - targeted for first-time release 2-2-2
  - State
    - interstate movement of live biological control organisms 3-2-3
  - States
    - lists of threatened and endangered species 3-2-2
  - Subcommittee on Biological Control of Weeds 2-1-2
- T**
  - TAG-BCAW Chair
    - member involvement assessment 2-2-6
    - TAG-BCAW final recommendation 3-1-1
    - term 2-1-3

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z



- TAG-BCAW Executive Secretary 2-1-3
  - duties 2-2-3
  - petition responses 2-2-2
  - TAG-BCAW Reviewer's Comment Sheet 5-2-17
- TAG-BCAW meetings 2-2-5
  - annual meeting 2-2-4
  - duties of Chair 2-2-3
  - duties of Executive Secretary 2-2-3
  - duties of members 2-2-2
- TAG-BCAW members
  - representative of respective organization 2-2-6
- TAG-BCAW recommendations 2-1-3, 2-3-1
- Technical Advisory Group for Biological Control Agents of Weeds (TAG-BCAW) 2-1-3–2-1-4
  - charter 2-2-1, 2-2-2
- techniques 4-2-5
- territory
  - permit for interstate movement of live biological control organisms 3-2-3
- test plant lists
  - alteration of previously approved 5-1-11
  - commenting on proposed 3-2-2
  - distribution to TAG-BCAW 2-2-3
  - flow chart 3-1-2
  - no-choice testing 4-3-5
  - not reviewed prior to petition 5-1-11
  - previously prepared and reviewed by TAG-BCAW 5-1-11
  - receipt acknowledgment 2-2-4
  - review due date assignment 2-2-3
  - submitting proposed list early 3-2-2
  - TAG-BCAW advise related to 2-1-3
  - TAG-BCAW Chair review 2-4-3
  - TAG-BCAW Manual reference guide for 1-1-1
  - TAG-BCAW member review and evaluation 2-3-1
  - TAG-BCAW review 2-1-4, 2-2-2
  - target weed information on 5-1-5
  - threatened and endangered species 3-2-2
- test plants
  - conducting tests on relevant phenological stages of 4-3-4
  - inclusion of 2-1-3, 2-2-2
- threatened and endangered species lists
  - TAG-BCAW reviewers and researchers review of 3-2-2
- tribal governments
  - contact with Federally-recognized 3-2-8
- tribal implications 3-2-8
- tribal officials
  - APHIS consultation and collaboration with 3-2-8
- U**
  - U.S. Army Corps of Engineers 1-1-4
    - TAG-BCAW 2-2-5
  - U.S. Environmental Protection Agency (EPA) 1-1-4
  - U.S. Fish and Wildlife Service (USFWS)
    - TAG-BCAW member A-1-2
    - TAG-BCAW membership 2-2-6
  - U.S. Geological Survey (USGS) 1-1-4
  - TAG-BCAW membership 2-2-6
  - U.S. Territories
    - permits for importation of live biological control organisms 3-2-3
  - United States
    - cover page 5-1-3
    - National collections for specimens 4-2-9
    - permits for importation of live biological control organisms 3-2-3
  - United States Department of Agriculture (USDA)
    - cooperating organization 1-1-4
  - United States Department of Defense (USDOD)
    - cooperating organization 1-1-4
  - United States Department of Interior (USDI) 1-1-4
  - USDA Forest Service (FS)
    - TAG-BCAW member A-1-1
  - USDA-APHIS
    - TAG Executive Secretary A-1-1
    - TAG-BCAW member A-1-3
  - USDI Bureau of Reclamation (BR)
    - TAG-BCAW member A-1-3
  - USDI-National Park Service A-1-2
  - USFWS consultations 3-2-6
- W**
  - weed biological control organism
    - permit for removal from containment 3-2-6
  - Weed Science Society of America (WSSA)
    - cooperating agency 1-1-4
    - perspective 2-3-9
    - TAG-BCAW membership 2-2-6
  - Weed Science Society of America Representative A-1-3
  - weeds
    - classical biological control 2-1-1
  - Working Group on Biological Control of Weeds 2-1-2

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z