Special Report

# Guidelines for Introducing Foreign Organisms into the U.S. for Biological Control of Weeds

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Research on biological control of weeds in the United States began early in this century with the use of introduced insects to control the weed lantana (*Lantana camara* L.) in Hawaii. The highly successful program for biological control of St. Johnswort (*Hypericum perforatum* L.), sometimes called "Klamath weed," in California by the use of introduced insects in the 1940s and 1950s increased interest in this approach to weed control. As a result, the U.S. Department of Agriculture established two overseas laboratories—in Rome, Italy, in 1959 and near Buenos Aires, Argentina, in 1962—to study arthropod natural enemies of a number of weeds that had been introduced into the United States. The recent and successful use of an introduced rust pathogen (*Puccinia chondrillina* Bubák & Syd.) to control rush skeletonweed (*Chondrilla juncea* L.) in Australia and the production and utilization of pathogens for controlling weeds in the United States have spurred further interest in biological control.

Huffaker (12) provided an early review of U.S. biological control of weeds programs. Since then, a number of authors have reviewed the subject and the procedures used for such importation programs (1–4,6–11,13–18).

Early in the development of the biological control of weeds programs in the United States, an advisory group was established at the request of biological control researchers who were seeking 1) advice on potential conflicts of interest (ie, on whether plants targeted for study were universally regarded as "weeds") and 2) recommendations regarding plants against which exotic phytophagous arthropods (ie, plant-feeding insects and mites) proposed for introduction into the United States should be tested. This group was established in December 1957, first as a subcommittee and later as the Working Group on Biological Control of Weeds (WGBCW) under the weed committees of the U.S. Department of Agriculture (USDA) and U.S. Department of the Interior (USDI), which meet jointly.

The Working Group currently consists of 11 members representing a diverse range of expertise and special interests (Table 1) from whom advice and counsel are sought on proposed releases of exotic organisms into the United States for biological weed control. The current chairman of the Working Group is Dayton L. Klingman, Weed Science Laboratory, ARS, USDA, Beltsville, MD 20705.

Since its establishment, the Working Group has broadened its responsibilities to include not only responding to questions concerning conflicts of interest and selection of test plants but also evaluating the adequacy of the data showing the safety of —and the need for—the release of exotic organisms for control of weeds. In this respect, the Working Group has come to serve as a principal advisor not only to biological control researchers but also to the Plant Protection and Quarantine (PPQ) programs of the USDA Animal and Plant Health Inspection Service (APHIS), the organization with the final legal authority for issuance of federal permits for introduction, movement, and release in the United States of organisms that attack plants.

In recent years, guidelines have evolved which illustrate for researchers the type of data necessary and the procedures to be followed in regard to the Working Group and with PPQ and state regulatory offices. In view of the still increasing number of

**Table 1.** Organizational representation on the Working Group on Biological Control of Weeds, 1982

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|---|
| **U.S. Department of Agriculture** |
| Science and Education |
| Agricultural Research Service (ARS) (four members representing weed science, entomology, plant pathology, and botany) |
| Cooperative States Research Service (one member representing state research interests) |
| Animal and Plant Health Inspection Service |
| Plant Protection and Quarantine (one member representing federal and state regulatory interests) |
| Forest Service |
| Timber Management Research (one member) |
| **U.S. Department of Interior** |
| Fish and Wildlife Service (one member) |
| Bureau of Land Management (one member) |
| **Environmental Protection Agency** |
| Office of Pesticide Programs, Criteria and Evaluation Division (one member) |
| **U.S. Army Corps of Engineers** |
| Waterways Experiment Station, Wetland and Terrestrial Habitat Group (one member) |

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**Table 2.** U.S. quarantine facilities currently (1982) approved as receiving centers for foreign organisms for study as agents for biological control of weeds

| Facility | Primary mission[a] and types of organisms to be contained |
|---|---|
| **U.S. Department of Agriculture** | |
| Biological Control of Weeds Laboratory<br>ARS-WR<br>1050 San Pablo Avenue<br>Albany, CA 94706<br>*Telephone*: (415)486-3757 | Exotic weed-feeding arthropods |
| Quarantine Facility<br>Grassland, Soil and Water Laboratory<br>ARS-SR<br>P.O. Box 748<br>Temple, TX 76501<br>*Telephone*: (817)774-1201 | Exotic arthropods for control of brush and range weeds |
| Stoneville Research Quarantine Facility<br>U.S. Delta States Agricultural Research Center<br>ARS-SR<br>P.O. Box 225<br>Stoneville, MS 38776<br>*Telephone*: (601)686-2311 | Exotic arthropod parasites and predators of arthropod pests; exotic weed-feeding arthropods; limited receipt and diagnosis of exotic entomopathogen materials; study of endemic plant pathogens for weed control |
| Biological Pest Control Research Unit<br>ARS-SR<br>P.O. Box 1269<br>Gainesville, FL 32602<br>*Telephone*: (904)372-3503 | (This unit is located with the state-operated facility) |
| Plant Disease Research Laboratory<br>ARS-NER<br>P.O. Box 1209<br>Frederick, MD 21701<br>*Telephone*: (301)663-7344 or 663-2333 | Exotic plant pathogens for weed control |
| **State** | |
| Quarantine Laboratory<br>Hawaii Department of Agriculture<br>1428 South King Street<br>Honolulu, HI 96814<br>*Telephone*: (808)548-7172 | Exotic parasites and predators of arthropod and snail pests; exotic weed-feeding arthropods |
| Quarantine Laboratory<br>Department of Entomology<br>Division of Biological Control<br>University of California<br>Riverside, CA 92521<br>*Telephone*: (714)787-5703 | Exotic arthropod parasites and predators of arthropod and snail pests; exotic terrestrial weed-feeding arthropods; aquatic weed-feeding arthropods and vertebrates (fish); limited receipt and diagnosis of exotic entomopathogen materials |
| Plant Pathology Department<br>University of Florida<br>Gainesville, FL 32611<br>*Telephone*: (904)392-3631 | Exotic plant pathogens for control of weeds |
| Biological Control Laboratory<br>Division of Plant Industry<br>Florida Department of Agriculture and Consumer Services<br>P.O. Box 1269<br>Gainesville, FL 32602<br>*Telephone*: (904)372-3505 | Exotic arthropod parasites and predators of arthropod pests; exotic arthropods for control of terrestrial and aquatic weeds |
| Beneficial Insects Quarantine Laboratory<br>Department of Entomology<br>Virginia Polytechnic Institute and State University<br>Blacksburg, VA 24061<br>*Telephone*: (703)961-5832 | Exotic arthropod parasites and predators of arthropod pests; exotic weed-feeding arthropods |

[a]The mission of all facilities includes the host specificity study and quarantine clearance of the type organisms listed and further shipment and field release of these organisms (when cleared by federal and state officials).

workers involved in biological control of weeds (3), including entomologists, weed scientists, and plant pathologists, publication of the most recent (1980) revision of the Working Group's guidelines, so as to reach the largest number of researchers of these disciplines as possible, should be of public and scientific value.

Descriptions of the procedures for conducting a biological control research program are contained in a number of references cited in this paper. These should be referred to for scientific procedural details. The "Guidelines" published here are intended to supplement those procedural descriptions, to include a regulatory viewpoint, and to guide the biological control researcher as he proceeds with plans leading to the importation and release of exotic weed control organisms, including phytophagous arthropods, plant nematodes, and plant pathogens.

The guidelines have been developed by members of the Working Group and C. J. DeLoach (USDA Grassland, Soil and Water Laboratory, Temple, TX) and L. A. Andres (USDA Biological Control of Weeds Laboratory, Albany, CA). We have served as editors. The guidelines are given here in essentially the same form as the unpublished revision that has been made available to biological control of weeds research quarantine facilities, overseas stations, other researchers, and Working Group members.

The three appendices of the guidelines are omitted here. These are: 1) a list of current members of the Working Group, 2) a suggested format for documentation in support of a request for release of an organism for weed control, and 3) PPQ Form 526, "Application and Permit to Move Live Plant Pests and Noxious Weeds." Appendices 1 and 2 may be obtained from us. PPQ Form 526 is available from Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U.S. Department of Agriculture, Hyattsville, MD 20782.

An important requirement of biological control importation programs, as noted in these guidelines, is that all receipt of exotic weed control organisms and all testing in the United States of exotic organisms before approval for their field release must be conducted in quarantine facilities approved by APHIS-PPQ. A directory of the currently approved U.S. quarantine facilities is given in Table 2.

These guidelines have evolved over time in response to the experiences gained by interaction among researchers, regulatory officials, and the Working Group. Changes or refinement may be expected in the future, and comments are welcomed.

# Guidelines on Proposals to Introduce Foreign Organisms into the United States for the Control of Weeds

(Working Group on Biological Control of Weeds)

These Guidelines form an outlined procedure to be followed in researching and developing candidate organisms for the biological control of weeds. Because these organisms feed on plants, there is great concern that the host specificity of each is clearly delineated before being released into the North American environment. There is also concern that any studies done in domestic facilities be conducted under quarantine conditions to assure against unwanted escape. The Guidelines spell out these concerns and the steps needed to fulfill informational and operational requirements, and they should aid researchers in their studies.

It is recognized that each study will be somewhat different from all preceding studies and that flexibility will be needed in assembling the required information in the most efficient and complete form as possible. It is also recognized that in some study areas, complete information will not be available. For example, it is not important that the candidate organism should always have a binomial name, but it is important that it should be studied by an expert for recognition as an unknown or new species. The reporting format should be adhered to as outlined in the Guidelines. If appropriate information is unavailable, comments to that effect should be made with an indication as to what steps are being taken to get the missing information.

It is also important that the information on each candidate organism be reviewed by the Working Group on Biological Control of Weeds of the U.S. Department of Agriculture (USDA) and U.S. Department of the Interior (USDI) Weed Committees (hereafter referred to as the Working Group), and perhaps other knowledgeable persons, before release of the organism into the environment is made. The Guidelines are designed to assure that the information necessary for consideration by the Working Group has been assembled. Any deviation from these Guidelines should be explained. There shall be no deviation in the permit and handling procedures without proper clearance from the Plant Protection and Quarantine Programs (PPQ), Animal and Plant Health Inspection Service (APHIS). These Guidelines also contain a general outline of the duties of the Working Group on Biological Control of Weeds.

## I. General summary of procedures

The Plant Quarantine Act of 1912 and the Federal Plant Pest Act of 1957 prohibit the importation and movement of plant pests, pathogens, vectors, and articles that might harbor these organisms, unless authorized by the USDA. These regulations are enforced by the PPQ of the Animal and Plant Health Inspection Service of the USDA. The Working Group was established to review proposals and provide recommendations to the researcher and PPQ in regard to testing and release of biological organisms to control unwanted plants. The Working Group reviews proposals for the selection of target weeds that may involve introduction of foreign organisms, recommends test plants on which host specificity studies should be conducted, and reviews the adequacy of results showing safety for release of the organism into the environment.

Membership of the Working Group represents a broad spectrum of scientific disciplines concerned with the effects of introducing foreign organisms. Current members are shown in Appendix 1 and additional members may be appointed by the Chairman to consider specific proposals. The Working Group members should also seek advice of specialists on the taxonomy, biology, and ecology of the organisms being considered for importation, as needed.

Biological control quarantine facilities and procedures have been designed to provide the means to gather information on the advisability of the release of biological control organisms, and to do so in as safe a manner as possible. The determination of the adequacy of quarantine facilities for laboratory testing of foreign organisms, and of the technical competence of investigator(s), is the responsibility of PPQ and the pertinent State Department of Agriculture. Determining the requirements that must be met for introduction of such organisms into quarantine is also their responsibility. The Working Group shares responsibility by providing advice that will minimize risks associated with testing and releasing exotic organisms to control weeds. Plants in North America that have economic, ecologic, aesthetic, or other values must be safeguarded. The Working Group may suggest a set of requirements that must be met before they will concur that release from quarantine can be made. Accordingly, the procedure outlined in Sections II, III, IV, and V below should be followed, although there may be some flexibility in the order of events. Proposals to the Working Group to introduce beneficial organisms may follow the suggested outline in Appendix 2 [of the Guidelines].

The more important conditions of testing and release of exotic organisms for the biological control of weeds in the United States as reflected in these Guidelines are:

(a) Authoritative identification of both the organisms and their hosts is required. (See section III)

(b) All domestic testing of exotic organisms prior to approval for their release must be conducted under quarantine conditions, in facilities approved by PPQ. (See section IV)

(c) Organisms sent to the U.S. must be shipped in containers meeting USDA standards, and must be shipped under PPQ permit. (See section IV)

(d) Colonies in quarantine shall be destroyed if test results indicate the organisms will be a pest of valued plants. (See section IV)

(e) Voucher specimens of the biological organisms and target weed are required. (See sections IV and V)

(f) No dispersal of the organisms to other researchers or laboratories shall be made without PPQ approval. (See section V)

## II. Selection of target weeds

It is important that research proposals involving the introduction of foreign organisms for control of weeds be reviewed by the Working Group at the earliest possible time so that advice can be offered on potential conflicts of interests, and to list plant species on which host specificity test information will be required. Research workers should prepare such proposals and send 13 copies to the Chairman of the Working Group. Advice from Canadian and Mexican officials will be sought at this time by the Working Group. [In selecting the target weed, it is suggested that consideration be given to the 12 points noted by Cavers and Mulligan (5), with particular emphasis on their items 3, 4, 6, and 10–13.]

A. The researcher will notify the Working Group of the intention to study the biological control of a particular weed, and provide documentation that it is a weed, on its geographic distribution, its growth characteristics, and nature of its damage and extent as a weed, as well as any beneficial values or uses it may have, not only in the U.S., but also in Canada, Mexico, and Central America. Dollar figures concerning crop or other losses caused by the weed and costs of its control, versus, if applicable, dollar figures concerning its beneficial qualities, should be provided if available.

B. The Working Group will give the researcher an indication of the importance of the weed and whether a conflict-of-interest over control of the plant may exist in the U.S., Canada, or Mexico. If a potential conflict does exist, the Working Group will advise as to the type of evidence that might be needed to resolve this conflict. The Working Group will also indicate what consideration must be given to other plant species, especially during the testing phase of the program, to establish specificity and safety of the biocontrol agent.

## III. Introduction into quarantine facilities within the continental United States

If at all possible, the researcher will follow the procedures indicated below prior to requesting State and PPQ authorization to import foreign organisms for weed control into domestic quarantine facilities. However, it may be occasionally necessary for the researcher to request State and PPQ permission to conduct such preliminary studies in domestic quarantine facilities prior to identification of the organism or other preliminary overseas studies, in order to facilitate the research. This request for early quarantine importation will generally be considered by PPQ on a case-by-case basis. Though the Working Group may occasionally be asked by PPQ for advice, responsibility for issuance of permits for quarantine importation will be solely with PPQ.

[PPQ has provided the following explanatory comments in regard to approval for early quarantine importations (paraphrased from comments by P. J. Lima, *personal communication*, October 1981): One reason for importation of living candidate agents before a serious study is initiated, is to determine if the agent will attack or feed on the target weed growing in the United States. In this instance, the agent is fairly well known both taxonomically and biologically, but the U.S. species of plant may have antagonistic varietal differences from the plant population in the foreign homeland of the agent proposed for study. Another case in which PPQ could approve is when permission is requested for importation of a living, exotic potential agent, taxonomically unknown, into quarantine for identification purposes. In both instances, neither breeding nor host specificity testing is intended before biological and taxonomic studies have been completed. To protect against the importation and possible establishment of plant pests in the U.S., these early quarantine importations should be limited to solving taxonomic problems of short duration.]

A. On the basis of an authoritative identification of the organism, the researcher will make a thorough literature survey to ascertain whether the potential biological control organism has ever been recorded as a pest, and an indication of its host range.

B. The researcher will assemble pertinent taxonomic and biological information on the biological control organism, including collection and distribution records for the organism and related species, and their economic importance. Field observations of the organism under study will be assembled, especially any notes on its association with plants other than the target weed. If the organism occurs in proximity with established overseas facilities where tests can be made, preliminary evaluation studies should be conducted at these facilities. Field observations and open air evaluation experiments *must* be handled overseas in USDA facilities or in other foreign laboratories.

C. All information obtained in points A and B above will be submitted by the researcher to the Working Group on Biological Control of Weeds. [A suggested format for reporting this information to the Working Group is contained in Appendix 2 of the Guidelines.] *Send 13 copies of the report to the Chairman of the Working Group.* This report should also include: (1) Names of the persons who will conduct the quarantine studies, and of the facility where the studies will be conducted (along with comments on the technical competence or experience of the personnel and security of the facility, if not already known to the PPQ or the Working Group); (2) Comments for sole use of PPQ indicating why it is necessary to carry out such studies in the U.S. (comments of particular importance if host specificity screening tests, identification of the organism, or other pertinent information relating to the potential hazard characteristics of the organism(s) to be imported, have not been gathered on foreign soil); and (3) An outline of the testing procedures planned for the organism, including a list of the proposed test plants.

D. At this time, an application for an import permit, Section A of PPQ Form 526 [Appendix 3], should be initiated, if not already done, by the researcher who will be receiving the material; the Federal Plant Pest Act requires that the applicant be a resident of the U.S. The application, *together with a copy of the researcher's report to the Working Group*, should be sent to the State regulatory official in the State into which the proposed quarantine importation is to be made. The State official will indicate his action in Section B of the PPQ 526, and will forward the form to PPQ. This action by the researcher notifies the State and PPQ that quarantine importations are being considered. PPQ will notify the Working Group of this intended importation, with a copy of the PPQ 526 showing State recommendations.

E. Upon receipt of the report and test plan submitted by the researcher and/or of a PPQ 526 application via PPQ, the Working Group will advise the researcher and/or PPQ on the selection of additional test plant species, on specifically suggested safeguards during the domestic quarantine testing phase, and on other matters relating to fulfillment of requirements necessary to clear the organism for ultimate release in North America. If the importation is approved by PPQ, shipping labels and a copy of the permit will be issued to the researcher (applicant) by PPQ and PPQ will send copies of the import permit to the State, PPQ regional office, and Working Group. The permit will indicate the conditions required. If *not* approved, the application will be returned to the researcher by PPQ, with the reasons for denial, with copies to the State and Working Group. If the requested importation of the organism into quarantine is not approved by PPQ, the researcher may attempt to correct the reason for denial after which subsequent requests for importation may be made to PPQ, which will be processed in the same manner as the initial request.

## IV. Testing in domestic quarantine facility

All tests conducted in domestic facilities must be carried out under strict quarantine conditions in a PPQ-approved facility. Packages that minimize the chances of escape of organisms en route to the quarantine facility are extremely important and must be used, and should have the appropriate shipping permit label issued by PPQ prominently displayed. The researcher will determine whether additional testing phases should be conducted overseas, depending upon the required safety and accuracy for each particular phase of the testing. Field observations and open air evaluation experiments *must* be handled overseas in USDA facilities or in other foreign laboratories (see section III B). Initial testing, in all cases, will emphasize plants of recognized economic, ecologic, or aesthetic importance that would appear to be at risk from the organism. If at any time the organism no longer shows promise as a candidate for biological control of weeds the quarantine colonies will be destroyed. State, Federal, and Working Group officials will be informed of any change in the status of the work.

Voucher specimens of the foreign organism will be verified by qualified taxonomists; voucher specimens of test plants also should be similarly verified. Arthropod voucher specimens will be deposited in the Insect Identification and Beneficial Insect Introduction Institute, Beltsville Agricultural Research Center, Beltsville, MD 20705. Voucher herbarium specimens, representing target weed plants used in testing, will be deposited in the U.S. National Arboretum Herbarium, Washington, DC 20002. Other plant specimens used in testing will be retained by the researcher at least until the biological control organism has been cleared for release or permission for release has been denied. Voucher specimens of plant pathogens under study will be deposited with the Plant Disease Research Laboratory, Frederick, MD 21701. Voucher specimens of plant nematodes under study will be deposited with the Nematology Laboratory, Beltsville Agricultural Research Center, Beltsville, MD 20705.

**V. Release into the field within the continental United States**

A. Once testing has been completed the researcher will prepare a summary report, including all information pertaining to the host specificity and potential value or detriment of the organism. *Thirteen copies of this report will be submitted to the Working Group* in support of a request to PPQ for the approval for release of the organism in the United States. [A suggested format for reporting this information to the Working Group is contained in Appendix 2 of the Guidelines.]

B. At this time, applications for permits for field release, Section A of PPQ Form 526 (see Appendix 3) may be initiated by the researcher. (However, the researcher may also elect to await Working Group recommendations before submitting the application.) The application(s), together with copies of the researcher's report to the Working Group (and Working Group comments, if previously received), is (are) to be sent to the regulatory official(s) of the State(s) in which release(s) is (are) intended. The State official(s) will indicate his (their) action in Section B of the PPQ 526, and will forward the form to PPQ. This action by the researcher notifies the State(s) and PPQ that release of the organism is being considered. PPQ will notify the Working Group of this intended release, with a copy of the PPQ 526 application(s) showing State recommendations, and will withhold action on the PPQ 526 application(s) until Working Group advice is received for review.

C. Upon receipt of the report proposing a release from the researcher, and/or a PPQ 526 application via PPQ, the Working Group will 1) seek comments on the proposed release of the organism in North America from Canadian and Mexican scientists and from other scientists as pertinent, and 2) will advise the researcher and/or PPQ of its own consensus conclusions; i.e., approval, disapproval, or a recommended need for additional information prior to a recommendation concerning the proposed release. PPQ will take into consideration the recommendations of the Working Group and State and foreign officials, in completing section C of PPQ 526. If approved, shipping labels, if required, and a copy of the permit(s) are issued to the researcher (applicant) by PPQ, indicating field releases may be initiated. Additional copies of the permit(s) will be sent to the State(s) involved and to the Working Group. If releases are *not* approved, the application(s) will be returned to the researcher by PPQ, with an indication of the reasons for denial, with copies to the State(s) and the Working Group. A subsequent request may be made by the researcher if the initial denial is based on a need for additional supporting information, and such information is supplied with a subsequent application. Subsequent requests will be processed through the Working Group and other officials in the same manner as the initial request.

D. Once PPQ has issued the appropriate release permits, the researchers may begin field releases in authorized States. State approvals and PPQ permits are required for any subsequent releases in or movements to any new States. Voucher specimens documenting the initial release of the biological control agent in the U.S. are required for deposit in the collections outlined in section IV. When additional importations of species previously approved for release are requested, voucher specimens should be authoritatively identified and be deposited in the collection of the quarantine facility. Information on the place and date of release and on the origin of the specimens should accompany these voucher specimens.

E. The Working Group will be kept informed of progress in aspects of biological control of weeds research relating to its functions, by periodic, at least annual, summaries of progress, pertinent reprints describing results of research or releases, and other type reports.

**LITERATURE CITED**


1. Andres, L. A. 1981. Biological control of naturalized and native plants: Conflicting interests. Pages 341-349 in: Beltsville Symposia in Agricultural Research, 5: Biological Control in Crop Production. G. C. Papavizas, ed. Allanheld, Osmun & Co., Montclair, NJ, and Granada Publishing, Ltd., London. 461 pp.
2. Andres, L. A., Davis, C. J., Harris, P., and Wapshere, A. J. 1976. Biological control of weeds. Pages 481-499 in: Theory and Practice of Biological Control. C. B. Huffaker and P. S. Messenger, eds. Academic Press, New York. 788 pp.
3. Andres, L. A., and Kok, L. T. 1981. Status and prospects for biological control of weeds in the U.S.A. Pages 27-33 in: Proceedings of the Joint American-Soviet Conference on Use of Beneficial Organisms in the Control of Crop Pests. J. R. Coulson, ed. Entomological Society of America, College Park, MD. 62 pp.
4. Batra, S. W. T. 1981. Biological control of weeds: Principles and prospects. Pages 45-49 in: Beltsville Symposia in Agricultural Research, 5: Biological Control in Crop Production. G. C. Papavizas, ed. Allanheld, Osmun & Co., Montclair, NJ, and Granada Publishing, Ltd., London. 461 pp.
5. Cavers, P. B., and Mulligan, G. H. 1972. A new series—The biology of Canadian weeds. Can. J. Plant Sci. 52:651-654.
6. Charudattan, R., and Walker, H. L., eds. 1982. Biological Control of Weeds with Plant Pathogens. John Wiley & Sons, New York. 293 pp.
7. Freeman, T. E., ed. 1978. Proceedings of the IV International Symposium on Biological Control of Weeds. University of Florida, Gainesville. 299 pp.
8. Frick, K. E. 1974. Biological control of weeds: Introduction, history, theoretical and practical applications. Pages 204-223 in: Proceedings of the Summer Institute on Biological Control of Plant Insects and Diseases. F. G. Maxwell and F. A. Harris, eds. University Press of Mississippi, Jackson. 647 pp.
9. Goeden, R. D. 1978. Biological control of weeds. Pages 357-414 in: Introduced Parasites and Predators of Arthropod Pests and Weeds: A World Review. C. P. Clausen, ed. U.S. Dep. Agric. Agric. Handb. 480. 545 pp.
10. Harris, P. 1973. The selection of effective agents for the biological control of weeds. Can. Entomol. 105:1495-1503.
11. Harris, P., and Zwölfer, H. 1968. Screening of phytophagous insects for biological control of weeds. Can. Entomol. 100:295-303.
12. Huffaker, C. B. 1959. Biological control of weeds with insects. Annu. Rev. Entomol. 4:251-276.
13. Huffaker, C. B. 1964. Fundamentals of biological weed control. Pages 631-649 in: Biological Control of Insect Pests and Weeds. P. DeBach and E. I. Schlinger, eds. Reinhold Publishing Corp., New York. 844 pp.
14. Templeton, G. E., TeBeest, D. O., and Smith, R. J., Jr. 1979. Biological weed control with mycoherbicides. Annu. Rev. Phytopathol. 17:301-310.
15. U.S. Department of Agriculture. 1978. Biological Agents for Pest Control: Status and Prospects. U.S. Government Printing Office, Washington, DC. 138 pp.
16. Wapshere, A. J. 1974. Host specificity of phytophagous organisms and the evolutionary centres of plant genera and subgenera. Entomophaga 19:301-309.
17. Wilson, C. L. 1969. Use of plant pathogens in weed control. Annu. Rev. Phytopathol. 7:411-434.
18. Zwölfer, H., and Harris, P. 1971. Host specificity determination of insects for biological control of weeds. Annu. Rev. Entomol. 16:159-178.