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# Petition to introduce *Aphthona nigriscutis* Foudras (Chrysomelidae) to the United States for leafy spurge (*Euphorbia esula* L.) control

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## Introduction

Leafy spurge is a serious pest of the Great Plains region of North America. It is native Eurasia (from Spain to Japan) but is not a problem in that region. The plant has been the target of biological control research in Canada and the U.S. for more than 20 years. This research has resulted in the introduction of a complex of insects against the plant. Most of the insects have been introduced in the past 5 years but have not yet developed large enough populations to affect the weed.

Among the insects that are thought to have good potential as control agents for leafy spurge are Old World flea beetles belonging to the genus *Aphthona*. The larvae of the many *Euphorbia* feeding Aphthona species eat the root hairs and roots of their host spurges, while the adults feed on the leaves and flower bracts. Three species of *Aphthona* (*A. flava* Guill., *A. cyparissiae* (Koch) and *A. czwalinae* Weise) have recently been introduced to the United States. *Aphthona flava* and *A. cyparissiae* have become established. *Aphthona nigriscutis* Foudras is another member of this complex that appears to have promise. Commonwealth Institute of Biological Control entomologist A. Gassman evaluated the host plant specificity of *A. nigriscutis* for Canada[1]. Gassman found that the host range of the beetle appeared to be restricted to the genus *Euphorbia* (Euphorbiaceae). This is in agreement with the recorded host plants (*E. esula, E. cyparissias* L., *E. pannonica,* and *E. seguieriana* Neck) for *A. nigriscutis*. Limited larval development occurred on two plants outside the Euphorbiaceae. One of 100 first instar larvae that were transferred to *Linum usitatissimum* L. (Linaceae) developed to the third instar (mature). Similarly 1 of 100 first instar larvae transferred to *Vinca minor* L. (Apocynaceae) developed to the third instar. Neither of these plants supported adult feeding. Twenty adult beetles placed on *L. usitatissimum* were dead after 5 days, as compared to 8 of 20 on Canadian

[1] Gassman, A. 1985. *Aphthona nigriscutis* Foudras (Coleoptera:Chrysomelidae): a candidate for the biological control of cypress spurge and leafy spurge in North America. CIBC European Station Report. Delémont, Switzerland.

leafy spurge (*E. esula*), which still had a few adults alive after 30 days. Adult longevity was not examined on *Vinca minor*, but it seems improbable that the limited larval development on these two plants was little more than laboratory artifact.

Based upon a host specificity level limited to species in the genus *Euphorbia*, Canada obtained clearances to introduce *A. nigriscutis*. Populations are now established in Alberta and Saskatchewan, and the numbers of *A. nigriscutis* have been increasing quickly. ARS, APHIS and university scientists would like to introduce *A. nigriscutis* to the United States.

## Considerations for introduction to the United States

*Euphorbia* feeding insects, which are candidates for release in the U.S. as biological controls of leafy spurge, usually undergo more testing, than if they are to be released in Canada. The United States has 112 native species belonging to the genus *Euphorbia* (sensu lato) whereas Canada has only about 12 species. In addition nine of these U.S. *Euphorbia* species are rare species, currently under review for federally protected status. Two additional rare Florida species (*E. garberi* Engelm. ex Chapm. and *E. deltoides* Engelm, ex. Chap.) currently have this legal protection.

These native plant realities and the associated legal considerations necessitate the selection of candidate insects with more narrow host ranges than is the case in Canada. I have tried to find and introduce insects that are specific to the subgenus *Esula* of the genus *Euphorbia*. This subgenus has 21 U.S. native species and a few exotics, including leafy spurge. If a candidate insect is specific to this level, most of the U.S. natives and all but a few of the rare review species are excluded as potential host plants. Fortunately, most of the *Euphorbia* feeding insects, including all 3 *Aphthona* species I have studied and introduced, have had host ranges below the subgenus Esula level.

## Evaluation against U.S. native, *Euphorbia*

In July 1988, adult *A. nigriscutis* were collected from a population established on leafy spurge at the Blood Indian Reservation in southern Alberta, Canada, through the helpful cooperation of Alec McClay of the Alberta Environmental Center at Vegreville. The beetles were brought to the new Montana State Univ. Quarantine at Bozeman for host specificity testing. Table 1 shows the native *Euphorbia* species tested by ARS at Bozeman and by Gassman at the CIBC Delémont, Switzerland laboratory. These plants are representatives of the various subgenera of the genus *Euphorbia* occurring in the U.S. Many are sympatric with leafy spurge, some could act as bridges to carry insects from the leafy spurge area to other areas where rare species occur. Three are rare species, two are weedy and four are ornamental. *Euphorbia telephiodes* Chap. and *E. purpurea* (Raf.) Fernald are rare species belonging to the subgenus Esula, the same group to which leafy spurge belongs. *Euphorbia hooveri* L.C. Wheeler is rare subgenus Chamaesyce species from California, not far from leafy spurge populations. The ARS test plants were selected to complement those tested by CIBC to create a selection from which the potential host range of *A. nigriscutis* in the U.S. could be predicted.

**Table 1. Native euphorbias used in host specificity testing for *Aphthona nigriscutis.***

| | | | Sympatric with leafy spurge | Potential bridge | Rare Review species | Weed | Ornamental | Tested by |
|---|---|---|---|---|---|---|---|---|
| *Euphorbia heterophylla* | Ann. | Poinsettia | X | X | | X | X | CIBC |
| *E. antisyphilitica* | Peren. | Chamaesyce | X | X | | X | economic | CIBC |
| *E. maculata* | Ann. | Chamaesyce | | | X | | | |
| *E. hooveri* | Ann. | Chamaesyce | | | X | | | ARS |
| *E. purpurea* | Peren. | Esula | X | | X | | | ARS |
| *E. telephiodes* | Peren. | Esula | | | X | | | ARS |
| *E. incisa.* | Peren. | Esula | possibly | | | | | ARS |
| *E. spatulata* | Ann. | Esula | X | X | | | | ARS |
| *E. marginata* | Ann. | Agaloma | X | X | | | X | CIBC |
| *E. corollata* | Peren. | Agaloma | X | X | | | X | CIBC |

Table 2 summarizes the ARS-Bozeman research. Ten pots of each test plant species were used, except for *E. telephiodes* for which only 7 pots were available. The potted test plants were placed inside glass-topped wooden sleave cages, to which 3 or 6 females and 1 male were added for each plant, from July 29 to Aug. 4, 1988. Fifteen females from the Alberta collections were dissected before the tests were begun. All were found to have fully developed eggs. I then assumed that the females in the population were mated which allowed the use of primarily females in the tests. This was desirable since the female to male sex ratio was more than 5:1. Adult feeding, was monitored for 4 weeks, except on *E. telephiodes*, which was monitored for only two weeks due to severe powdery mildew infection it developed. From Nov. 15 to 22 the plants were dissected to detect larval feeding damage to the roots and the presence of larvae.

Table 2 shows the results of the tests. All of the subgenus Esula *Euphorbia* species supported adult feeding. The rare species (*E. purpurea* and *E. telephiodes*) received somewhat less feeding than *E. spatulata* Lam., *E. incisa* Engelm. or the control *E. esula*. No feeding occurred on *E. hooveri*, the rare Chamaesyce species. The dissections indicated that only the control, *E. esula*, supported larval development. All ten *E. esula* plants had root damage and larvae present. A mean of 38.2 (range 1-111) *A. nigriscutis* larvae were found in ten *E. esula* pots. An average of 3.3 (range 0-12) second instar larvae were counted and 34.9 (range 1-108) third instar larvae were found. *Aphthona* species have three larval instars. The ability to develop to the third instar has been the accepted criteria for development in testing *Aphthona* species, since the overwintering larval mortality in the laboratory is very high. Two *E. incisa* plants may have had a little feeding damage on the roots.

**Table 2. Summary of *Aphthona nigriscutis* host specificity testing on native *Euphorbia* species at Bozeman, MT, 1988.**

| Test Plant | Number of Plants | Number of females per plant | % of plants with adult feeding | % of plants with root damage | % of plants with larvae |
|---|---|---|---|---|---|
| *E. hooveri* (Chamaesyce) | 10 | 6 | 0 | 0 | 0 |
| *E. spatulata* (Esula) | 10 | 5 | 100 | 0 | 0 |
| *E. incisa* (Esula) | 10 | 6 | 100 | 20 ? | 0 |
| *E. telephiodes* (Esula) | 7 | 5 | 42.8 | 0 | 0 |
| *E. purpurea* (Esula) | 10 | 6 | 70 | 0 | 0 |
| **CONTROL** | | | | | |
| *E. esula* (Esula) | 10 | 6 | 100 | 100 | 100 |

Table 3 indicates the *Euphorbia* species that were evaluated for larval development by the CIBC and ARS. With the exception of *E. turicalli*, a member of the Old World subgenus *Euphorbium*, all of the plants supporting larval development are members of the subgenus Esula. Since only six of the twelve subgenus Esula species tested supported development, *A. nigriscutis* appears to be restricted to a level somewhat below the subgenus Esula level. Importantly neither of the rare review subgenus Esula species (*E. purpurea* and *E. telephiodes*) appear to be acceptable hosts. Since only 3 of 100 1st instar larvae transferred by Gassman to *E. turicalli* were able to develop to the third instar, *E. turicalli* is probably not a suitable host in nature. Even if Euphorbium subgenus *Euphorbia* species were acceptable to *A. nigriscuti*s, it would have little bearing on its proposed introduction to the U.S., since members of Euphorbium are confined to the warm parts of the Old World, primarily Africa.

The host range of *A. nigriscutis* appears to be similar but somewhat more narrow than the three *Aphthona* species approved for release in recent years. I recommend its introduction.

Gassman indicated that *A. nigriscutis* occurs on dry sites in Europe, which may give the beetle an ability to do well on the dry range sites that are infested with leafy spurge in America. The root feeding of *A. nigriscutis* has the potential to cause water stress in the plants. In dry land situations this could be particularly detrimental to leafy spurge.

**Table 3. *Euphorbia* species supporting larval development of *Aphthona nigriscutis.***

| Test species | Subgenus | Native Area | CIBC | ARS (Bozeman) |
|---|---|---|---|---|
| *Euphorbia esula* | Esula | Old World | + | + |
| *E. oblongata* | Esula | Old World | + | - |
| *E. lathyris* | Esula | Old World | + | - |
| *E. polychroma* | Esula | Old World | + | - |
| *E. amygdaloides* | Esula | Old World | + | - |
| *E. seguieriana* | Esula | Old World | 0 | - |
| *E. pepulus* | Esula | Old World | 0 | - |
| *E. myrsinites* | Esula | Old World | + | - |
| *E. spatulata* | Esula | New World | - | 0 |
| *E. incisa* | Esula | New World | - | 0 |
| *E. telephiodes* | Esula | New World | - | 0 |
| *E. purpurea* | Esula | New World | - | 0 |
| *E. maculata* | Chamaesyce | New World | 0 | - |
| *E. hooveri* | Chamaesyce | New World | - | 0 |
| *E. heterophylla* | Poinsettia | New World | 0 | - |
| *E. pulcherrima* | Poinsettia | New World | 0 | - |
| *E. antisyphilitica* | Agaloma | Now World | 0 | - |
| *E. marginata* | Agaloma | New World | 0 | - |
| *E. corollata* | Agaloma | New World | 0. | - |
| *E. tirucalli* | Euphorbium | Old World | + | - |
| *E. milii* | Euphorbium | Old World | 0 | - |