

# Petition for the release of *Aphthona cyparissiae* against leafy spurge in the United States<sup>1</sup>

ROBERT W. PEMBERTON

## Part I

TO: Dr. R. Bovey, Dept. of Range Science  
USDA/ARS/SR  
Texas A&M University  
College Station, TX 77843 U.S.A.

Enclosed are the results of the research on the flea beetle *Aphthona cyparissiae* (Chrysomelidae). This petition is composed of two parts. The first is the report “*Aphthona cyparissiae* (Kock) and *A. flava* Guill. (Coleoptera: Chrysomelidae): Two candidates for the biological control of cypress and leafy spurge in North America” by G. Sommer and E. Maw which the Working Group reviewed on Canada’s behalf. Copies of this report should be in the Working Group’s files. This research, which was done at the Commonwealth Institute of Biological Control’s Delémont, Switzerland lab, showed *A. cyparissiae* to be specific to the genus *Euphorbia* of the Euphorbiaceae. This result agrees with the literature and field records for *A. cyparissiae*, which recorded it from: *Euphorbia cyparissias*, *E. esula*, *E. peplus*, *E. seguieriana*, and *E. virgata*. The Sommer and Maw report also included information on *A. cyparissiae*’s taxonomic position, life history, laboratory biology, mortality factors, feeding effects on the host plants, the Harris scoring system, as well as a brief description of the target plant – leafy spurge (*Euphorbia esula* complex), a serious pest of the rangelands of the Great Plains of North America. Based on this research, the Working Group gave permission to release *A. cyparissiae* in Canada and to import it into the USDA’s Biological Control of Weeds Quarantine in Albany, California, for additional testing.

Part II of this petition reports the results of the host specificity testing in Albany. The testing at Albany was undertaken to try to predict what the potential host plant range within the genus *Euphorbia* could be if *A. cyparissiae* were released in the United States. The laboratory oviposition, adult feeding, and adult longevity tests against 10 representative *Euphorbia* species indicated that *A. cyparissiae* is probably restricted to species within the subgenus *Esula*. This suggests that fewer than 19 of the 111 native North

---

<sup>1</sup> This petition was submitted to Dr. R. Bovey, Dept. of Range Science USDA-ARS-SR Texas A&M University, College Station, TX 77843

American spurges could become possible host plants. Of the 19 subgenus *Esula* species which are possible host plants, only 5 species (excluding *E. purpurea*) are sympatric with leafy spurge. Neither of the subgenus *Esula* species (*E. telephioides* and *E. purpurea*), which are under review for endangered status, supported oviposition, although there was adult feeding and a limited amount of long-term adult survival (one female lived 4 months on *E. purpurea*).

*A. cyparissiae*'s level of host specificity appears to be similar to that of *A. flava* which was cleared for introduction in the United States last year. The host range seems to be broad enough for it to accept the various forms and hybrids of leafy spurge and yet narrow enough to exclude use of all but a few of the numerous spurges which are native to North America. Both the adults and the larvae damage the host plants, the adults feeding on the leaves and the larvae in the roots. The main effect of *A. cyparissiae* feeding on leafy spurge will probably be water stress through reduction of absorptive roots.

If permission is granted for the introduction of *A. cyparissiae* in the United States, releases will begin in the 1986 season.

## Part II

### **Host plant specificity testing of *Aphthona cyparissiae* (Koch) (Chrysomelidae) against *Euphorbia* species which are native to North America**

Robert Pemberton AND Gerald Johnson

USDA Albany Biological Control of Weeds Group

## Introduction

The purpose of the host plant specificity testing in Albany was to study and, hopefully, predict what the host range of *Aphthona cyparissiae*, within the genus *Euphorbia*, could become if this flea beetle is released in the United States. This was desirable because there are 111-112 spurges (107 *Euphorbia* and 4-5 *Chamaesyce* spp.) native to America north of Mexico. Among these are 9 rare species, which are under review by the U.S. Dept. of the Interior for listing as legally protected, endangered or threatened species. Two Florida species of *Euphorbia* (*E. garberi* and *E. deltoides*) in the subgenus *Chamaesyce* are federally protected endangered and threatened species.

The *Euphorbia* floras of North America and Europe, to which *A. flava* is native, are somewhat different. In Europe all but 4 of 105 native *Euphorbia* belong to the subgenus *Esula*, the group to which leafy spurge belongs. The other four species are members of the subgenus *Chamaesyce*. In addition to the subgenus *Esula* with 21 species, North America has the subgenera *Agaloma* with 26 species, *Poinsettia* with 3 spp., and *Chamaesyce* with 57 species. All of the host records for *A. cyparissiae* and the other *Euphorbia* feeding insects from Europe are from host plants belonging to the subgenus *Esula* and therefore provide no indication of whether the North American *Poinsettia*, *Ag-*

aloma and Chamaesyce spurges could become hosts. The subgenera of the genus *Euphorbia* are not only useful ways of dealing with the large number of species in the genus, but also appear to be quite “natural” groupings, which reflect true phylogenies within the genus. Many of the *Euphorbia* feeding insects respond to these subgenera, accepting as host plants most of the species in one or more of the subgenera and rejecting the species in other subgenera. These subgenera were the basis for selecting test plants and for providing the conceptual framework to judge the host plant specificity of *A. cyparissiae* and other candidate insects.

*A. cyparissiae* was brought into quarantine at the USDA’s Albany laboratory on the basis of the host specificity testing done at the Delémont Switzerland laboratory of the Commonwealth Institute of Biological Control by Sommer and Maw. Their work showed this flea beetle to be specific to the genus *Euphorbia*. Table 1 summarizes the results of the testing of *Euphorbia* species by both Delémont and Albany. *Euphorbia maculata*, *E. marginata*, *E. corollata*, and *E. heterophylla* are U.S. spurges, which were tested in Delémont.

Table 1 shows the plants which were used in the host plant specificity testing of *A. cyparissiae* at Albany. The plants were selected to represent the four different subgenera (Agaloma, Chamaesyce, *Esula*, and Poinsettia) of the genus *Euphorbia*, which occur in North America. Most of the species (9 of 10) are sympatric with leafy spurge, and 7 of the 10 species could act as bridges to rare protected and review species. *Euphorbia purpurea* and *E. telephioides* are test plants because they are under review and are closely related to leafy spurge (subgenus *Esula* species). *Euphorbia maculata*, and *E. heterophylla* L. are test plants because they are at times reported as weedy (Dunn 1979).

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

Species	Habit	Subgenus	Sympatric with leafy spurge	Potential bridge	Endangered species	Weed	Ornamental
<i>Euphorbia heterophylla</i>	Ann.	Poinsettia	X	X		X	X
<i>E. maculata</i>	Ann.	Chamaesyce	X	X		X	
<i>E. serphyllifolia</i>	Ann.	Chamaesyce	X	X			
<i>E. robusta</i>	Peren.	<i>Esula</i> section <i>esula</i>	X	X			
<i>E. spatulata</i>	Ann.	<i>Esula</i> section <i>galarrhoei</i>	X	X			
<i>E. purpurea</i>	Peren.	<i>Esula</i> section not placed	X		X		
<i>E. telephioides</i>	Peren.	<i>Esula</i> section <i>ippeccacuaehae</i>			X		
<i>E. incisa</i>	Peren.	<i>Esula</i> section <i>esula</i>	possibly				
<i>E. marginata</i>	Ann.	Agaloma	X	X			X
<i>E. corollata</i>	Peren.	Agaloma	X	X			X

*Euphorbia marginata* (snow on the mountain), *E. corollata* (flowering spurge), and *E. heterophylla* (fire plant) are cultivated as ornamentals (Bailey 1951). An effort has been made to select native species that possess a number of the desired characteristics in order to reduce the number of test species needed.

The test plants were grown in 9 cm. fiber pots, from seeds, cuttings and root pieces. The soil used was “UC mix” modified to match the edaphic conditions of the specific test species. *Euphorbia purpurea*, *E. telephioides*, and *E. robusta* proved difficult to obtain and slow growing. The adult *A. cyparissiae* used in the testing, were obtained from *Euphorbia esula* growing at St. Polten, Austria.

## Procedures

The host specificity testing strategy was first to do a combination adult feeding, adult longevity and oviposition tests with all of the test species.

If oviposition or significant longevity occurred on *Euphorbia* species outside the subgenus *Esula* or on the rare *E. telephioides* or *E. purpurea* within the subgenus *Esula*, then larval transfer tests would be done on those species to see if they could support development. Since *A. cyparissiae* laid eggs and lived a long time only on subgenus *Esula* species, the larval transfer tests were not necessary.

Two tests were run to make best use of the varying numbers and availabilities of both the beetles and the test plants. The plant species in the two tests were different except for the control – leafy spurge (*E. esula virgata*) and *E. telephioides*. Ten individuals of each test species were used in the testing (five individuals of *E. telephioides* were used in both the tests). In both tests a male and female of *A. cyparissiae* were placed inside a 15-dram ventilated plastic cylinder, which enclosed a leafy branch of the test plant growing in a pot. A moist paper towel was wrapped around the base of the enclosed branch within the cylinder (Fig. 1). *A. cyparissiae*, as with *A. flava*, normally oviposits in the soil around the base of its host plant. Both species will readily lay eggs between the paper toweling of the stems of acceptable host plants. Periodic removal and examination of the toweling allows the number of eggs to be readily determined. The number of eggs laid in soil at the stem bases of plants can be difficult to accurately determine. The number of eggs laid per test species and the percentage of individual test plants receiving eggs were recorded. The presence or absence of adult feeding and the number of adults living at the end of one and then two months was recorded for each test plant.

## Results and discussion

Tables 2 and 3 show the results of the tests. Eggs were laid only on leafy spurge (*E. esula-virgata*) and two closely related subgenus *Esula* species: *E. incisa* and *E. robusta*. All of the leafy spurge plants and *E. incisa* plants, and 80% of the *E. robusta* plants supported oviposition. The large number of eggs laid (an average of from 17 to more than 50 eggs per plant) indicated that the beetles were behaving normally within the confines of the plastic cylinders.

Adult feeding occurred only on *E. purpurea*, *E. telephioides*, *E. spatulata* and *E. serpyllifolia*, all subgenus *Esula* species. Adults surviving one and two months, after the

tests began, were on the same three species (leafy spurge, *E. incisa* and *E. robusta*), which supported oviposition. A single female lived for almost four months on *E. purpurea*, although 19 of 20 of the test beetles on *E. purpurea* died within the first month. This compares with 6 of 20 dying within the first month on the leafy spurge plants.

**Table 2. Adult feeding and oviposition at Albany.**

	# plants tested	# insects (male-female pairs)	feeding	Eggs found	adults living			
					1 month females	1 month males	2 months females	2 months males
Test 1								
<i>E. esula virgata</i> ( <i>Esula</i> )	10	10	+	513	7	7	4	2
<i>E. incisa</i> ( <i>Esula</i> )	5	5	+	194	3	3	2	–
<i>E. robusta</i> ( <i>Esula</i> )	5	5	+	171	3	4	1	–
<i>E. purpurea</i> ( <i>Esula</i> )	10	10	+	–	1	–	1 (1 female almost 4 months no eggs deposited)	
<i>E. telephioides</i> 9 ( <i>Esula</i> )	5	5	+	–	–	–		
<i>E. maculata</i> ( <i>Chamaesyce</i> )	10	10	–	–	–	–		
<i>E. corollata</i> ( <i>Agaloma</i> )	10	10	–	–	–	–		
<i>E. marginata</i> ( <i>Agaloma</i> )	10	10	–	–	–	–		
<i>E. heterophylla</i> ( <i>Poinsettia</i> )	10	10	–	–	–	–		
Test 2								
<i>E. esula-virgata</i> ( <i>Esula</i> )	10	10	+	437	8	8	Test 2 ended in 1 month as all insects on test plants were dead.	
<i>E. spatulata</i> ( <i>Esula</i> )	10	10	+	–	–	–		
<i>E. telephioides</i> ( <i>Esula</i> )	5	5	+	–	–	–		
<i>E. serphyllifolia</i> ( <i>Chamaesyce</i> )	10	10	–	–	–	–		

**Table 3. Summary of *Apthona cyparissiae* host plant specificity testing on native North American *Euphorbia* species, Albany 1985, and the target weed *E. esula-virgata*.**

Test Plant Species	Subgenus	% of plants with adult feeding	% of plants supporting oviposition	% of adults living 1 month or longer
<i>Euphorbia esula-virgata</i>	<i>Esula</i>	100	100	75
<i>Euphorbia incisa</i>	<i>Esula</i>	100	100	60
<i>Euphorbia robusta</i>	<i>Esula</i>	80	80	70
<i>Euphorbia purpurea</i>	<i>Esula</i>	60	0	10
<i>Euphorbia telephioides</i>	<i>Esula</i>	40	0	0
<i>Euphorbia spatulata</i>	<i>Esula</i>	10	0	0
<i>Euphorbia maculata</i>	Chamaesyce	0	0	0
<i>Euphorbia serphyllifolia</i>	Chamaesyce	0	0	0
<i>Euphorbia corollata</i>	Agaloma	0	0	0
<i>Euphorbia marginata</i>	Agaloma	0	0	0
<i>Euphorbia heterophylla</i>	Poinsettia	0	0	0

Table 4 summarizes the results of the *Apthona cyparissiae* testing against selected *Euphorbia* species in both Delémont and Albany. Neither of the species outside the subgenus *Esula* supported larval development nor oviposition. Within the subgenus *Esula* the rare species (*E. purpurea* and *E. telephioides*) and the annual (*E. spatulata*) were unsuitable for oviposition and larval development. The subgenus *Esula* contains 21 of the 112 *Euphorbia* species native to America north of Mexico. Only two of the five subgenus *Esula* tested appear to be acceptable host plants for *A. cyparissiae*. This indicates that many (perhaps most) of the 21 species are not potential host plants. The subgenus *Esula* species, which are sympatric with leafy spurge are:

	<u>Species</u>	<u>Acceptability</u>
1.	<i>Euphorbia crenulata</i>	(unknown)
2.	<i>E. lurida</i>	(unknown)
3.	<i>E. robusta</i>	(acceptable)
4.	<i>E. spatulata</i>	(unacceptable)
5.	<i>E. obtusata</i>	(unknown)
6.	<i>E. purpurea</i>	(unacceptable)

It appears that *E. robusta* could easily become a host plant for *A. cyparissiae* and that three other *Euphorbia* species, with ranges overlapping leafy spurge, might become hosts. It is also possible that *A. cyparissiae* could use acceptable host plant species as bridges to reach other susceptible subgenus *Esula* species living beyond the range of leafy spurge. The test data indicate *A. cyparissiae* would use the minority of the 21 native *Esula Euphorbia* species even if it could reach them. The host specificity of *A. cyparissiae*

appears to be broad enough to attack to various forms of leafy spurge and yet narrow enough to exclude the vast majority of native *Euphorbia* species (including the rare and protected species).

**Table 4. *Apthona cyparissiae* acceptance of species within the genus *Euphorbia*.**

Test species	Subgenus	Delémont (larval development)	Albany (oviposition)
<i>Euphorbia esula-virgata</i>	<i>Esula</i>	+	+
“ <i>incisa</i> (U.S. native)	“		+
“ <i>robiusta</i> (native)	“		+
“ <i>spatulata</i> (native)	“		—
“ <i>oblongata</i>		+	
“ <i>peplus</i>	“	+	
“ <i>lathyris</i>	“	+	
“ <i>amgdaloides</i>	“	+	
“ <i>seguieriana</i>	“	+	
“ <i>telephioides</i> (native)	“		—
“ <i>purpurea</i> (native)			—
“ <i>polychroma</i>	“	+	
“ <i>maculata</i> (native)	Chamaesyceae	-	—
“ <i>serphylifolia</i> (native)	“		—
“ <i>corollota</i> (native)	Agaloma	—	—
“ <i>marginata</i> (native)	“	—	—
“ <i>antisyphilitica</i>	“	—	
“ <i>pulcherrima</i>	Poinsettia		—
“ <i>heterophylla</i> (native)	“	+ (1 larva made 3rd instar 0.9% of those transferred)	—
“ <i>tirucalli</i>	Euphorbium	—	
“ <i>milli</i>	“	—	

+ = complete development  
- = failed to complete development

*A. cyparissiae* could be a useful addition to the complex of the biological agents under development to try to control leafy spurge. It may establish at more northerly areas than *A. flava* or perhaps different sites. In Europe the *Aphthona* feeding on *Euphorbia* species tend to occur in different habitats. Since leafy spurge in North America grows in many different habitats within its large range, it is desirable to use a complex of *Aphthona* species against it.

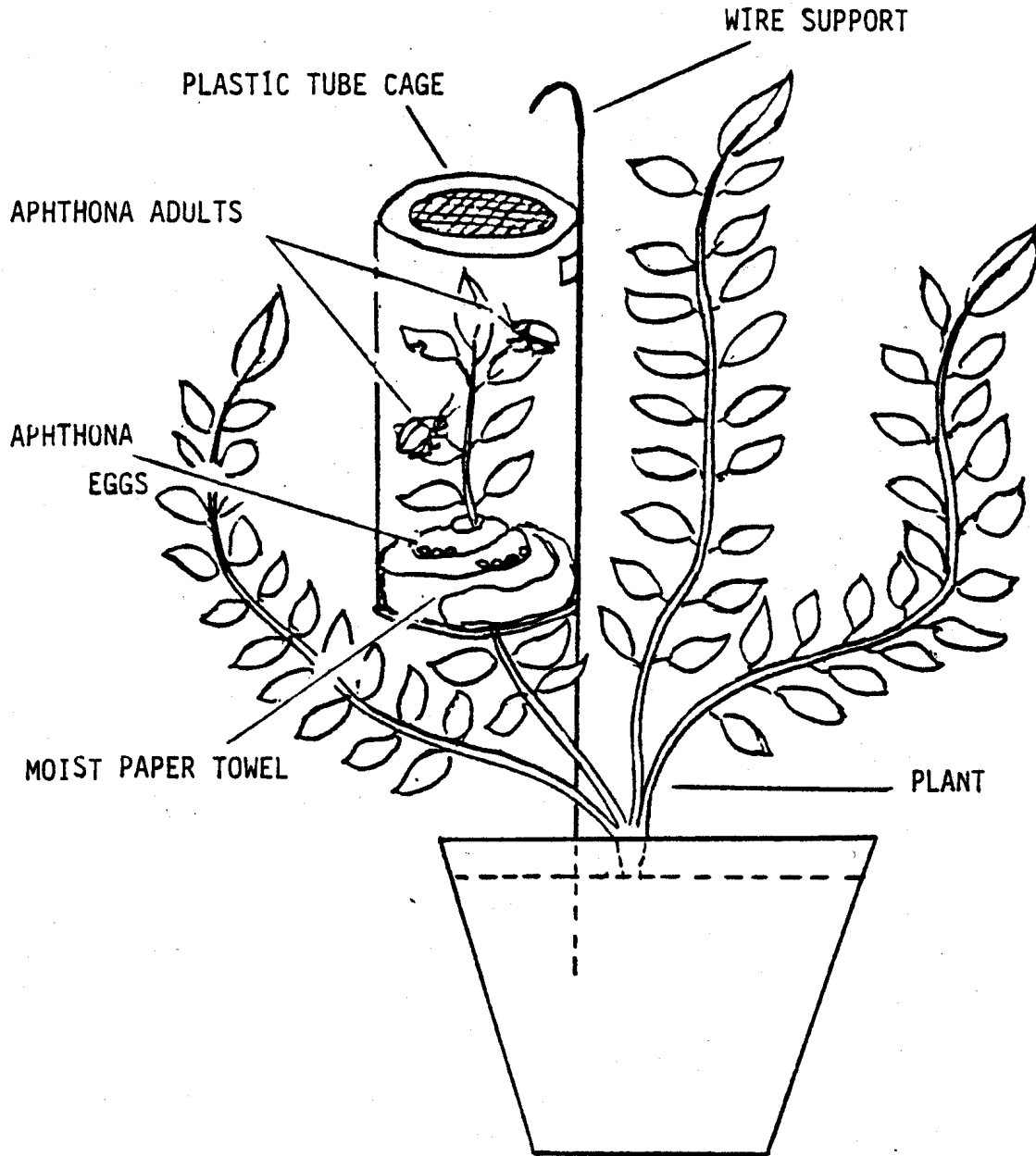


Fig. 1. Oviposition, adult feeding and longevity test set up.