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SURVEY FOR ORGANISMS ASSOCIATED WITH DYER'S WOAD, *ISATIS TINCTORIA* L. (BRASSICACEAE), IN CENTRAL ITALY, AND PRELIMINARY HOST SPECIFICITY TESTS FOR SOME POTENTIAL CONTROL AGENTS
(Insecta)

GAETANO CAMPOBASSO † (*), ENZO COLONNELLI (**) and HANK MC NEEL (***)

INTRODUCTION

Dyer's woad, *Isatis tinctoria* L. (Brassicaceae), is an invasive weed in the United States, easily recognized in the field during April, and May when its bright yellow flower clusters are present (fig. 1). It is an erect, herbaceous biennial that may also exist as a winter annual or short-lived perennial growing to 1-1.20 m in height. Immature plants exist as basal rosettes until flowering stems develop at maturity. Taproots of rosettes and mature plants penetrate the soil to an average depth of about 1 m, with most of the lateral root growth occurring in the top 30 cm of soil, especially during the second year of growth (Farah et al. 1988). Dyer's woad is native to southeastern Europe and Southern Asia, and grows wild from southeastern European Russia to China, Tibet, and Afghanistan (Varga and Evans 1978), and it has been historically important plant used in making indigo dyes (Pignatti 1982). It has been spread by man in six continents and in some cases had become a weed (Varga and Evans 1978). Roché (1992) reported that dyer's woad was first found in the United States near Brigham City, Utah in 1910 as a contaminant in alfalfa seed. Currently, dyer's woad persists as a weed in eight western states and threatens to invade others, particularly those with large amounts of rangeland and pasture (Callihan 1990). This weed also readily invades alfalfa and small grain fields, orchards, waste areas, and is to

(*) European Biological Control Laboratory, USDA-ARS, Rome Substation, Via Colle Trugli, 9 - 00132 Roma, Italy.
(**) Via delle Giunchiglie, 56 - 00172 Roma, Italy. E-mail: ecolonnelli@yahoo.it
(***) formerly at Bureau of Land Management, 5001 Southgate Drive, 59107 Billings, Montana. E-mail: hmcneel@mt.bnl.gov

be found also along waterways (Callihan 1990). *Isatis tinctoria* reduces crop and rangeland production by $ 2 billions in Utah (Evans and Chase 1981). Infestation is growing in scale and intensity generating widespread concern among land managers (Roché 1992). There are three major strategies used to manage dyer's woad in range and forests: hand-pulling, herbicides, and biological control. Grazing experiments using sheep to control dyer's woad in Utah indicated that the stocking rates required to damage a dyer's woad population would likely cause further deterioration of an already depleted range (West and Farah 1989). Hand-pulling of individual weeds is probably one of the simplest and most effective methods of dyer's woad control. However, the use of this method involves a significant labor investment that is not considered economically feasible. Control of dyer's woad in accessible areas can be accomplished by using herbicides or other traditional methods, but much of the infested land is either inaccessible to machinery or of low value so that herbicide applications cannot be applied economically. In addition, some of the areas affected are environmentally sensitive because of their proximity to urban centers, watersheds, or recreational areas. Regular herbicide applications in such areas are undesirable because of non-selective damage to the indigenous flora and concerns about public exposure. Biological control may provide an attractive alternative for managing dyer's woad on these lands. A native rust pathogen, identified as *Puccinia thlaspeos* Schub. was first discovered on dyer's woad in 1978 in southern Idaho, and has since spread into woad populations throughout Idaho and Utah (Kropp et al. 1995). Plants usually become infected in spring or early summer, though fall infections are also possible. Initial symptoms such as stunting, leaf distortion, and chlorosis in the bolting phase are typical for infected plants (Kropp et al. 1995).

In Italy there are three species in the genus *Isatis*, namely *I. tinctoria, I. allionii* P. W. Ball, and *I. praecox* Kitaibel. *Isatis tinctoria* ranges all across peninsular Italy except Sicily, Sardinia and from near sea level at Pescara (central Italy) to 1,400 m in the Abruzzes mountains (central Italy). *Isatis allionii* is distributed in the regions of Piedmont (northwestern Italy), Latium, Abruzzes, and in the Sibillini mountains (central Italy), while *I. praecox* is only found in the territory around Bergamo in the region of Lombardy in northern Italy (Pignatti 1982). Some of the insect species found on *I. tinctoria* were

also found on *I. allionii*. No investigation could be made about the fauna attacking *I. praecox*, because of its rarity and localized distribution.

Photos of the plants and of *Ceutorhynchus peyerimoffi* and *C. rusticus* were made using a JVC-GCX1E digital camera. Pictures of the above insects were then elaborated with the free program Combine Z5 by Alan Hadley.

Field Surveys

Isatis tinctoria plants were examined for insects in the Abruzzes region (Central Italy) three times per month, from January 2003 through December 2003. In addition, surveys were conducted in other Italian regions for *I. tinctoria* insects from April through June 2004. Survey sites included roadside fields, shoulders and embankments, and open fields near crops or abandoned fields. At each site, ectophagous insects were hand picked or aspirated from 10 to 50 plants depending on plant abundance. We aspirated by mouth from specific plant parts or by using a D-VAC®. for whole plant sampling. The letter "P" (= from whole plant) was used in tab. 1 to indicate D-VAC samples. Seedlings, rosettes, bolting, and flowering plants were selected without apparent bias and examined for endophagous insects in the field or after being transported to the laboratory. Immature insect stages were reared to maturity on excised plant material when possible and adults found resting on field plants were caged on leaf bouquets in the laboratory to confirm their ability to feed on *I. tinctoria*. In addition, 10 to 15 whole mature plants were dug up from each site. Some of these were held over the winter to observe emergence of endophagous insects, while others were dissected. Detailed collection and rearing records were kept to estimate the relative frequency of each insect species collected and to record the collection dates, plant association, and plant phenology. Frequency was reported as follows: (C) common, more than one insect of a species found per 10 plants ; (LC) locally common, less than one insect per 10 plants: (O) occasional, more than one insect per 100 plants; (R) rare, less than one insect per 100 plants . These categories were intended to be used only as a general index of species abundance.

A few spots around 2,000 m a.s.l. and above, where grows *I. allionii* were also surveyed by one of us (EC), and two weevils (Coleoptera: Curculionidae) were found attacking the plant. One of them, *Aulaco-*

baris kaufmanni (Reitter, 1894) damages roots, where *Ceutorhynchus* sp. near *peyerimhoffi* heavily feeds on leaves and young fruits.

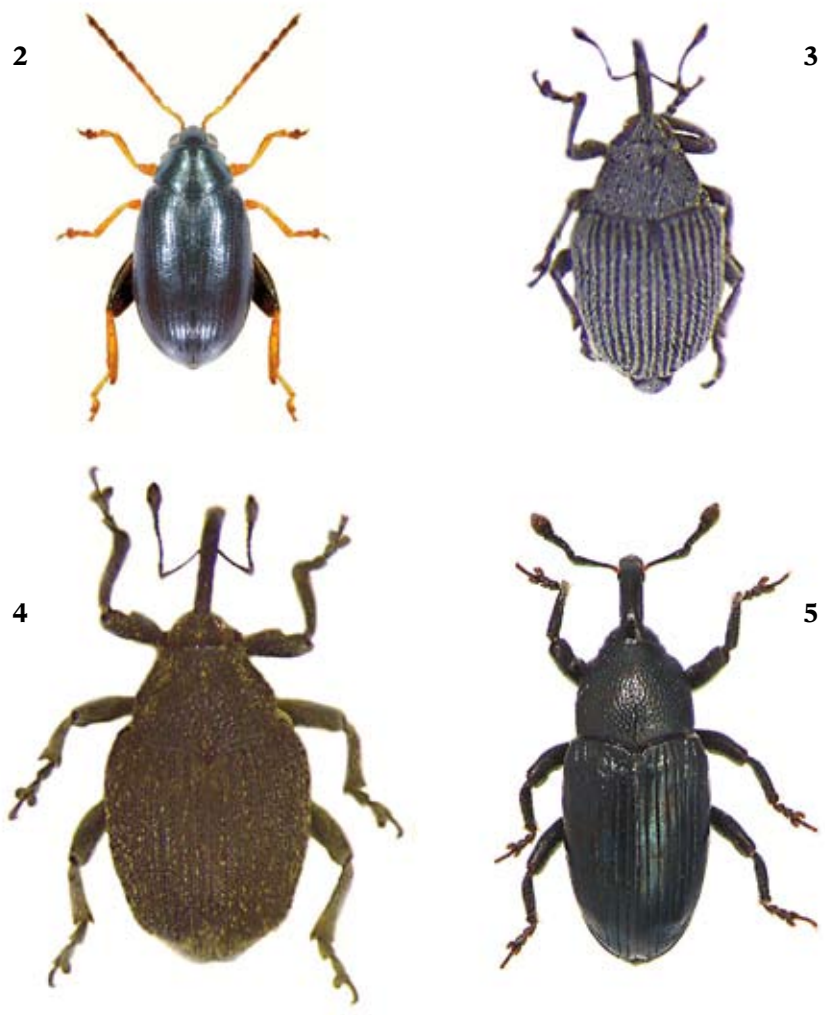
Host Range Testing

Preliminary host range testing were conducted with insects species not recorded to be pests of cultivated plants. Each species of insect was confined on potted plants covered by screen cages (20 cm diameter, 70 cm high) consisting of cloth (0.5 x 0.5 mm) provided with zippered windows supported by a metal frame. All tested plant species were inspected every two to five days and external feeding damage calculated in square mm, and total number of eggs were recorded. Preliminary host range tests were conducted in a greenhouse under fluctuating environmental conditions (15-25 °C, 60-70% relative humidity (RH), 14 to 16 h photoperiod). Tests were replicated 2 to 5 times depending on the availability of insects and plant species with 5-10 adult pairs used per replicate. Testing was conducted discontinuosly from 2003 through 2006. Data on insect variables were analyzed and are presented as means and standard deviation.

Isatis tinctoria was a main host, alternate host, or refuge for 126 species representing 25 families of 5 orders of insects (tab. 1). Thirty-six of the 126 species were endophagous. Seventy of the species collected were found to be polyphagous on Brassicaceae and other plant families, another 15 species were known to feed on plants in other genera and subgenera of Brassicaceae (Colonnelli 2004, Dieckmann

Fig. 1 – Flowering *Isatis tinctoria* L. near Bazzano, Abruzzes, Italy.

1972, Koch 1992, Oglobin and Rejkhardt 1932, Scherf 1964). Many of these species were discarded as prospective agents for biological control because they attack cultivated Brassicaceae (Jordheuil 1963, Scherf 1964). Many insects species were capable as adults of causing significant damage to *I. tinctoria* but they occurred only sporadically and did not reproduce on *I. tinctoria*. Only 4 species of insects were



Figs 2-5 – Habitus of: *Psylliodes isatidis* Heikertinger from the website www//biol.univ.wroc.pl (2); *Ceutorhynchus peyerimhoffi* Hustache from Italy, Abruzzes (3); *Ceutorhynchus rusticus* Gyllenhal from Italy, Abruzzes (4); *Aulacobaris fallax* (H. Brisout) from Bahr et. al (2007), photo F. Bahr (5). Not at the same scale.

Tab. 1 – Organisms associated with dyer's woad, *Isatis tinctoria* in Italy and their potential for biological control of the weed.

Taxon	Relative frequency	Months collected: Immature	Months collected: Adults	Plant association	Host specificity	Reference Economic Status
Coleoptera Anobiidae						
1. *Lasioderma serricorne* (F., 1792)	LC		X	P	*	
2. *Lasioderma* sp.	LC		XI	P	*	
Coleoptera Apionidae						
3. *Aspidapion radiolus* (Marsham, 1802)	O		X	P	*	
4. *Holotrichapion pisi* (F., 1801)	O		V-X	P	*	
5. *Holotrichapion* sp.	O		VI	P	*	
6. *Ischnopterapion virens* (Herbst, 1797)	LC		VI	P	*	
7. *Stenopterapion tenue* (Kirby, 1808)	O		V	P	*	
Coleoptera Bruchidae						
8. *Bruchidius nudus* (Allard, 1868)	LC		VI	L-P	*	
9. *Bruchidius* sp.	LC	IV	V	P	*	
10. *Bruchus ervi* Frölich, 1799	LC		VI-VI	P	*	
11. *Bruchus lentis* Frölich, 1799	LC		V-VI	P	*	
12. *Paleoacanthoscelides gilvus* (Gyllenhal, 1839)	LC		VI	L-P	*	
Coleoptera Cantharidae						
13. *Cantharis tristis* F., 1798	LC		V-VI	H-L-P	*	
Coleoptera Cerambycidae						
14. *Agapanthia villosoviridescens* (De Geer, 1775)	R		V-V	L-B-P	*	
15. *Agapanthia cardui* (L., 1767)	C		VI-VII	L-H-P	*	
16. *Agapanthia dahli* (Richter, 1821)	C		VI-VII	L-H-P	*	
17. *Calamobius filum* (Rossi, 1790)	LC		VI-VI	L-P	**	
18. *Clytus arietis* (L., 1758)	LC		VI	P-L	**	
19. *Opsilia coerulescens* (Scopoli, 1763)	O		VI	P	*	
20. *Phytoecia vulneris* Aurivillius, 1923	C		V-VI	P	**	

continued

Taxon	Relative frequency	Months collected: Immature	Months collected: Adults	Plant association	Host specificity	Reference Economic Status
Coleoptera Chrysomelidae						
21. *Altica brevicollis* Foudras, 1860	LC		V-VI	P	*	
22. *Altica carduorum* Guerin-Meneville, 1858	LC		V-VI	P	**	
23. *Altica oleracea* (L., 1758)	LC		VI	P	**	
24. *Cassida rubiginosa* O. F. Müller, 1776	R		V	L-P	**	
25. *Cassida margaritacea* Schaller, 1783	R			L-P	**	
26. *Galeruca pomonae* (Scopoli, 1763)	LC		VII	P	*	
27. *Galeruca rufa* (Germar, 1824)	LC		V-VI	P	*	
28. *Gastrophysa polygoni* (L., 1758)	LC		V-VI	P	*	
29. *Longitarsus suturellus* (Duftschmid, 1825)	LC		VI	P	**	
30. *Phyllotreta cruciferae* (Goeze, 1777)	LC		IV	L-P	*	
31. *Phyllotreta nemorum* (L., 1758)	LC	IV	V	L-P	**	
32. *Phyllotreta nigripes* (F., 1775)	LC	V		L-P	*	
33. *Phyllotreta undulata* Kutschera, 1860	LC	V		L-P	*	
34. *Psylliodes affinis* (Paykull, 1799)	R	III		L-P	*	Della Beffa 1961
35. *Psylliodes crysocephalus* (L., 1758)	R	III	V	L-B	**	Della Beffa 1961
36. *Psylliodes instabilis* Foudras, 1860	LC	III	V	P-L	**	
37. *Psylliodes isatidis* Heikertinger, 1912	C	III	IV-V	L-B	**	
38. *Psylliodes napi* (F., 1792)	C	II	V	L-P	**	Della Beffa 1961
39. *Psylliodes pyritosus* Kutschera, 1864	LC	III-IV	VI-VII	S-L-P	**	
40. *Sphaeroderma testaceum* (F., 1775)	LC		V-VI	P-L	*	Della Beffa 1961
Coleoptera Cleridae						
41. *Trichodes apiarius* (L., 1758)	LC		VI	L-P	*	
42. *Thanasimus formicarius* (L., 1758)	LC		V	L-B	*	
Coleoptera Coccinellidae						
43. *Coccinella quinquepunctata* L., 1758	O		V-VI	P	*	
44. *Coccinella septempunctata* L., 1758	O		VI-VII	P	*	
Coleoptera Curculionidae						
45. *Aulacobaris coerulescens* (Scopoli, 1763)	LC		IX-X	R	**	

continued

Taxon	Relative frequency	Months collected: Immature	Months collected: Adults	Plant association	Host specificity	Reference Economic Status
46. *Aulacobaris fallax* (H. Brisout, 1870)	C	III-IV	V-VI	RT-S-P	**	
47. *Bangasternus orientalis* (Capiomont, 1873)	O		VI	P	*	
48. *Ceutorhynchus assimilis* (Paykull, 1792)	LC		V-IX	L-P	**	
49. *Ceutorhynchus chalibaeus* Germar, 1824	C	IV	V-VI	B-H-P	**	
50. *Ceutorhynchus contractus* (Marsham, 1802)	LC		V-VI	H	**	
51. *Ceutorhynchus duvali* C. Brisout, 1869	O		VI	H	**	
52. *Ceutorhynchus erysimi* (F., 1787)	C	IV	V-VI	L-P	**	
53. *Ceutorhynchus peyerimhoffi* Hustache, 1916	C	III-IV	VI	B-H-P	***	
54. *Ceutorhynchus picitarsis* Gyllenhal, 1837	C	XII-IV	VI	Rt-Cr-P	**	
55. *Ceutorhynchus rusticus* Gyllenhal, 1837	C	XII-IV	VI	Rt-P	***	
56. *Ceutorhynchus sulcicollis* (Paykull, 1800)	LC		IV-VI	P	**	
57. *Cionus thapsus* (F., 1792)	O		VI	P	*	
58. *Graptus nictitans singularis* (Jacquelin duVal, 1854)	R		X	Rt	*	
59. *Hadroplontus trimaculatus* (F., 1775)	R		VI	P	*	
60. *Hypera nigrirostris* (F., 1775)	LC		VI	P	*	
61. *Hypera postica* (Gyllenhal, 1813)	O		VI	P	*	
62. *Hypera venusta* (F., 1781)	O		VI	P	*	
63. *Larinus carlinae* (Olivier, 1897)	O		V	H	*	
64. *Larinus iaceae* (F., 1775)	O		VI	P	*	
65. *Lixus cardui* Olivier, 1807	LC		V-VI	P	*	
66. *Lixus filiformis* (F., 1781)	LC		VI	P	*	
67. *Lixus vilis* (Rossi, 1790)	O		VI	P	*	
68. *Mecinus pascuorum* (Gyllenhal, 1813)	O		VI	P	*	
69. *Mecinus pyraster* (Herbst, 1795)	O		VI	P	*	
70. *Mogulones beckeri* (A. Schultze, 1900)	O		V	P	*	
71. *Mogulones geographicus* (Goeze, 1777)	O		VI	P	*	
72. *Otiorhynchus cribricollis* Gyllenhal, 1834	R		X	P	*	
73. *Otiorhynchus indefinitus* Reitter, 1912	R		VI	P	*	
74. *Phyllobius etruscus* Desbrochers, 1873	O		V	L	*	
75. *Phyllobius longipilis* Desbrochers, 1873	O		V-IX	P	*	
76. *Phyllobius maculicornis* Germar, 1824	LC		VI-VII	P	*	
77. *Phyllobius subdentatus* Boheman, 1843	R		VI	P	*	

continued

Taxon	Relative frequency	Months collected: Immature	Months collected: Adults	Plant association	Host specificity	Reference Economic Status
78. *Polydrusus cervinus* (L., 1758)	R		V	P	*	
79. *Polydrusus marginatus* Stephens 1831	O		VI	P	*	
80. *Polydrusus tibialis* Gyllenhal, 1834	O		VII	P	*	
81. *Rhinusa antirrhini* (Paykull, 1800)	C		VI	P	*	
82. *Rhinusa linariae* (Panzer, 1892)	LC		VII	P	*	
83. *Sibinia pellucens* (Scopoli, 1772)	R		VI	P	*	
84. *Sitona discoideus* Gyllenhal, 1834	R		IX	P	*	
85. *Sitona inops* Schoenherr, 1832	LC		IX	P	*	
86. *Sitona lineatus* (L., 1758)	R		VI	P	*	
87. *Stenocarus ruficornis* (Stephens, 1831)	R		IX	P	*	
88. *Strophomorphus porcellus* (Schoenherr, 1832)	R		X	P	*	
89. *Trichosirocalus troglodytes* (F., 1787)	O		V	H	*	
90. *Tychius bicolor* C. Brisout, 1862	O		VI	P	*	
Coleoptera Dermestidae						
91. *Anthrenus pimpinellae* F., 1775	LC		V	P	*	
92. *Anthrenus scrophulariae* (L., 1758)	LC		V-VI	P	*	
93. *Anthrenus verbasci* (L., 1767)	LC		V-VI	L-P	*	
Coleoptera Elateridae						
94. *Adrastus limbatus* (F., 1776)	R		V	P	*	
95. *Agriotes lineatus* (L., 1767)	LC		VI-VI	P	*	
96. *Cardiophorus discicollis* (Herbst, 1806)	LC		VI-VI	P	*	
97. *Cardiophorus rufipes* (Goeze, 1777)	LC		V-VI	P	*	
Coleoptera Meloidae						
98. *Meloe violaceus* Marsham, 1802	LC		V	P	*	
Coleoptera Melyridae						
99. *Axinotarsus* sp.	LC		X	P	*	
100. *Enicopus hirtus* (L., 1767)	LC		IX-X	P	*	
101. *Malachius* sp.	O		X	P	*	

continued

Taxon	Relative frequency	Months collected: Immature	Months collected: Adults	Plant association	Host specificity	Reference Economic Status
102. *Malachius aeneus* (L., 1758)	LC		IX	P	*	
103. *Melyris* sp.	LC			P	*	
Coleoptera Mordellidae						
104. *Mordellistena episternalis* Mulsant, 1856	LC		IX-X	P	*	
105. *Mordellistena pumila* (Gyllenhal, 1810)	LC		IX	P	*	
Coleoptera Nitidulidae						
106. *Meligethes anthracinus* C. Brisout, 1863	C		V-VII	P	*	
107. *Meligethes corvinus* Erichson, 1845	LC		VI	P	*	
108. *Meligethes nigrescens* Stephens, 1830	LC		VI-VII	P	*	
109. *Meligethes rotundicollis* C. Brisout, 1863	LC		V-VI	P	*	
110. *Meligethes* sp.	LC		V-VII	P	*	
Coleoptera Oedemeridae						
111. *Oedemera nobilis* (Scopoli, 1763)	LC		IV-V	P	*	
112. *Oedemera virescens* (L., 1767)	LC		V-VI	P	*	
Coleoptera Rhynchitidae						
113. *Coccigorhynchites sericeus* (Herbst, 1797)	O		VI	P	*	
Diptera Tephritidae						
114. *Acanthiophilus helianthi* (Rossi, 1790)	LC		V-VI	L-B	*	
115. *Urophora stylata* (F., 1775)	C		VI-VII	H	**	
Hemiptera Pentatomidae						
116. *Aelia rostrata* Boheman, 1852	LC		VI	P	*	
117. *Carpocoris mediterraneus* Tamanini, 1958	LC		VI	P	*	
118. *Eurydema oleraceum* (L., 1758)	LC		V-VI	P	**	
Hemiptera Pyrrhocoridae						
119. *Pyrrhocoris apterus* (L., 1758)	LC		VI	P	*	

continued

Taxon	Relative frequency	Months collected		Plant association	Host specificity	Reference Economic Status
		Immature	Adults			
Hemiptera Tingidae						
120. *Tingis* sp.	C		VI-VI	P	**	
Homoptera Aphrophoridae						
121. *Phylaenus spumarius* (L., 1758)	LC		V-VI	P	*	
Homoptera Cercopidae						
122. *Cercopis sanguinolenta* (Scopoli, 1763)	C		IV	L	*	
Homoptera Cicadellidae						
123. *Cicadella viridis* (L., 1758)	C		V-VI-VII	P-L	*	
Lepidoptera Pieridae						
124. *Pieris brassicae* (L., 1758)	LC	IV-V	VI-VII	P	**	
125. *Pieris napi* (L., 1758)	LC	IV-V	VI-VII	P	**	
126. *Pieris rapae* (L., 1758)	LC	IV-V	VI-VII	P	**	

C = common, > 1/10 plants. LC = locally common, < 1/10 plants. O = occasional >1/100 plants, R = rare, < 1/100 plants.
Cr = crown. H = flower heads. L = leaf. P = Plant. S = stem. Rt = root. B = leaf or flower buds.
r = reared to adult in laboratory.
*** = restricted to genus *Isatis*.
** = restricted to Brassicaceae.
* = occurs on host plants in other genus of Brassicaceae and/or in other plant families.

found to be sufficiently host specific when caged on test plants, namely a root feeding weevil *Ceutorhynchus rusticus* Gyllenhal (Coleoptera: Curculionidae), a seed feeding weevil *Ceutorhynchus peyerimhoffi* Hustache (Coleoptera: Curculionidae), a root-stem feeding weevil *Aulacobaris fallax* (H. Brisout) (Coleoptera: Curculionidae), and a flea-beetle *Psylliodes isatidis* Heikertinger (Coleoptera: Chrysomelidae).

Ceutorhynchus rusticus. The control plant *I. tinctoria* received a mean of mm^2 390.2 ± sd 113.6 mm^2 damage by *C. rusticus* and a mean of 31.2 ± sd 9.2 of eggs per replicate. Light damage was observed on *Brassica oleracea* L. (29.1 ± 8.8 mm^2), *Raphanus sativus* L. (36.2 ± 9.6 mm^2), and *Lactuca sativa* L. (21.4 ± 7.1. mm^2). No eggs were found on any other plant than *I. tinctoria*.

Ceutorhynchus peyerimhoffi. Adults feed primarily on seed-capsules while the larvae damage the inner tissue of seed capsules, thereby reducing or eliminating seed production. Adult damage produced a mean of 270 .1 ± 107.9 feeding punctures on *I. tinctoria*, with a mean 19.2 ± 8.9 eggs/first instar larvae observed on *I. tinctoria* seed-capsules. Light damage was observed on *Brassica oleracea,* a mean of 25.2 ± 13.3 mm^2 of feeding punctures was consumed. *Raphanus sativus* had a mean of 31.2 ± 7.6 and *Lactuca sativa* 17.8 ± 8.3 mm^2 of damage.

Aulacobaris fallax. Adult feeding damage averaged 615.8 ± 274.4 mm^2 per *I. tinctoria* test plant with a mean oviposition of 10.4 ± 3.5 eggs. Damage to and oviposition on other plants included *Brassica oleracea* (23.2 ± 8.3 mm^2 and 0 eggs), *Raphanus sativus* (22.2 ± 5.8 mm^2 and 0 eggs), and *Lactuca sativa* (20.6 ± 8.1 mm^2 and 0 eggs).

Psylliodes isatidis. Adults fed heavily and oviposited readily on *I. tinctoria* leaves producing a mean 447.5 ± 169.9 mm^2 damage and 14.4 ± 9.4 eggs. *Brassica oleracea, B. nigra* L, *Raphanus sativus*, and *Lactuca sativa* had a mean of 12.8 ± 2.7 mm^2, 15.8 ± 6.2 mm^2; 17 ± 4.7 mm^2; 17.8 ± 8.3 mm^2 of feeding damage, respectively. No eggs were observed on any of the aforementioned plants.

Discussion

The survey portion of this study found a high number of arthropods associated with the genus *Isatis* in central Italy. Collection dates indicated that *I. tinctoria* was attacked by many insects (both endophagous and ectophagous) thoughout its growing period and that several species of-

ten fed at the same time on different plant niches. Although the damage produced by ectophagous organisms was more apparent, a combination of ectophagous and endophagous insects which provides a sustained attack on multiple plant niches may have the greatest potential to suppress *I. tinctoria*. For example, the root feeding *Ceutorhynchus rusticus* fed on *I. tinctoria* for approximately eleven months. Interior portions of the stem were heavily damaged by *Aulacobaris fallax* which demolishes the inner part of the stem, causing cuts and holes that reduce wood texture and water storage capacity. Seed feeding insects like *Ceutorhynchus peyerimhoffi* may be employed to reduce or eliminate seed production. Finally, defoliation by *Psylliodes isatidis* may act to reduce the amount of photosynthetic surfaces of the plant, and it was quite specific when tested with some cultivated crops.

We recommend that more extensive host range studies be conducted on the aforementioned insect species to elucidate their physiological host range, especially with congeners and native species, in the invaded regions of the United States.

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SUMMARY

A survey conducted in central Italy found 126 species of phytophagous insects from five orders and 25 families on dyer's woad, *Isatis tinctoria* L., a biennial or short-lived perennial. About 75 % of the species found attacking this weed were polyphagous, 20% were restricted to the family Brassicaceae, and only 5% were restricted to the genus *Isatis*. Four of the one hundred twenty six species recovered were specific enough to merit further research as candidates for biological control of *I. tinctoria* L. in the United States. Preliminary host range tests were conducted for the weevils *Ceutorhynchus rusticus* Gyllenhal, *Ceutorhynchus peyerimoffi* Hustache, *Aulacobaris fallax* (H. Brisout), and the fleabeetle *Psylliodes isatidis* Heikertinger. All tests were conducted at the USDA-ARS-EBCL Rome substation from 2003 to 2006 and are reported herein.

RIASSUNTO

Indagini svolte nell'Italia centrale alla ricerca di organismi associati ad Isatis tinctoria *L. (Brassicaceae), e prove preliminari sulla specificità alimentare per l'uso di alcuni di essi come agenti per il controllo biologico della detta pianta (Insecta).*

Una ricerca svolta in Italia centrale ha portato al ritrovamento di 126 specie di insetti di cinque ordini e 25 famiglie su *Isatis tinctoria* L., una pianta biennale o perenne,

ma a corta vita. Circa il 75% delle specie rinvenute sono polifaghe, il 20% sono legate solo a specie di Brassicaceae, e solo il 5% sono specifiche del genere *Isatis*. Quattro delle 126 specie trovate si sono mostrate a sufficienza specifiche da meritare ulteriori ricerche quali candidate per il controllo biologico di *I. tinctoria* negli Stati Uniti. Test preliminari sono stati effettuati presso l'USDA-ARS-EBCL Rome substation dal 2003 al 2006 sui curculionidi *Ceutorhynchus rusticus* Gyllenhal, *Ceutorhynchus peyerimoffi* Hustache, *Aulacobaris fallax* (H. Brisout), e sul crisomelide alticino *Psylliodes isatidis* Heikertinger, ed i risultati vengono qui riportati.

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