# THE HOST SPECIALISATION OF THREE INSECTS AND A MITE LIVING ON CHONDRILLA JUNCEA L. 1/

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## INTRODUCTION

During investigations in Europe to discover biological control agents for the important Australian weed, Chondrilla juncea L. (skeleton weed), the specificity of certain arthropods to this plant host has been examined. The arthropods are two aphids, Uroleucon (Dactynotus) chondrillae Nev. and Chondrillobium blattnyi Pint., a Cecidomyid, Cystiphora (Laubertia) schmidti Rubs., and an Eriophyid mite, Aceria chondrillae Can.

## METHODS

Two methods have been used to confirm the specificity of these four arthropods to Chondrilla. The first, (that described by Harris and Zwolfer (1968) and Zwolfer and Harris (1971) and modified by Wapshere (this meeting) ), tests a group of cultivated plants considered at risk for various reasons and confirms the specificity by testing firstly against plants most closely related to the weed and passing to those more distantly related. The four arthropods were first tested against members of the Cichoriaceae, to which C. juncea belongs, then against other cultivated Compositae (Table 1). The second method was to test the arthropods against 62 major cultivated plants agreed on by the Australian quarantine authorities. Not all the Cichoriaceae were exposed to all the arthropods but on all occasions Lactuca sativa (lettuce), the only Cichoraceous plant of importance in Australia, was tested first. In addition various forms of the very polymorphic plant C. juncea including the Australian forms, which were to be the ultimate hosts, were exposed to the four biological control agents.

Because of lack of space only a brief discussion of the specificity of the four arthropods is given here, the description of the testing method and the detailed results have been prepared for publication elsewhere. During all tests, however, control Chondrilla plants were always exposed and readily infested by the arthropods tested.

## UROLEUCON (DACTYNOTUS) CHONDRILLAE

This brown, robust aphid feeds and completes its life cycle on all aerial parts of C. juncea. Colony multiplication is more rapid on the flower shoot than on the rosette. The large genus Dactynotus is almost confined to Compositae (Hille Ris Lambers, 1950). The host range of each species is relatively restricted although Mosbacher (1963) found that aphids of this genus can live on hosts closely related to the preferred host.

U. chondrillae is only recorded on members of the genus Chondrilla and is found frequently on C. juncea.

Detailed observations of the behaviour of the aphid on various Cichoriaceae (Table 1) at the rosette stage showed that only on Sonchus asper L. was breeding and development normal. Some reproduction and development occurred on rosettes of Crepis pulchra, Urospermum dalechampii and Helminthia echioides. The host range of the aphid was wider on Cichoraceous plants with flowering shoots. Normal reproduction occurred on Taraxacum officinale and Sonchus asper and reduced breeding on

Lagoseris sancta, Helminthia echioides and Reichardia picroides. Spontaneous colonies were found on Crepis capillaris and Crepis vesicaria. However, only Sonchus asper, on which three generations of the aphid were reared, was a host comparable to C. juncea.

Most Cichoriaceae were poor hosts for U. chondrillae, the aphid probing the plant and leaving within a short time. On Lactuca sativa (lettuce) the aphid fed for a short time (3-6 days) on young plants and some development of nymphs occurred. This aphid has never been observed on lettuce in the field and attempts to create field colonies on lettuce were unsuccessful.

Only two other Compositae were tested, Helianthus annuus and Carthamus lanatus, and the aphid left these plants immediately. Although the other non-Cichoraceous Compositae in Table 1 have been grown in close proximity for two years to aphid infested C. juncea plants, no U. chondrillae has been observed on them.

Only 51 out of the 62 major cultivated plants have been exposed to U. chondrillae but these represent 17 plant families. In all cases the aphids left the plant rapidly and no colonies have ever been observed on these cultivated plants (Hasan, unpublished data).

Two strains of U. chondrillae, one from Southern France (Aniane) and one from South-Eastern Italy (Vieste), have been tested against forms of C. juncea from Australia. The Aniane strain of the aphid did poorly on the most common Australian form of the plant (narrow leaf), the Vieste strain however attacked all Australian forms readily.

## CHONDRILLOBIUM BLATTNYI

This green aphid feeds and completes all its life cycle on C.juncea and colonies develop best beneath the rosette leaves. The genus Chondrillobium which has one species only, C. blattnyi, is considered by Eastop (personal communication) to be close to Pleotrichophorus which is also found on Compositae. C. blattnyi has only been recorded on C. juncea.

Detailed observations of the behaviour of the aphid on various Cichoriaceae (Table 1) revealed that all repelled this aphid and no breeding or development occurred. However, all Cichoraceous plants except Scorzonera hispanica were probed. The aphid stayed longest on Lactuca sativa (6 days). It has never been observed on this plant under cultivation.

The aphid also left the other Compositae tested (Table 1) within 4 days and Helianthus tuberosa and Tagetes sp. have been exposed to a spontaneous infestation on C. juncea without being infested.

The aphid rapidly left all the major cultivated plants except Beta vulgaris, Pisum sativum, Phaseolus vulgaris and Vicia faba. On the leguminosae it remained only 2 days. On B. vulgaris it took 8 days for the last aphid to leave and a few nymphs were laid.

Two strains of the aphid were used to test the Australian and European forms of C. juncea, one from Southern France (Aniane) and one from South-Eastern Italy (Vieste). Colonies of the Aniane strain developed readily on two of the Australian forms, intermediate and broad leaf, but it did poorly on the Greek and Australian narrow leaf forms of C. juncea. The Vieste strain of aphid did badly on both Aniane and Australian narrow leaf forms.

## CYSTIPHORA (LAUBERTIA) SCHMIDTI

The adult female of this Cecidomyid midge lays eggs beneath the epidermis of rosettes and flower shoots of Chondrilla. Round or elongate pustules develop within which all the larval life and the pupation of the midge occur. The genus Cystiphora is only recorded from Cichoraceous plants and C. schmidti has only been recorded from C. juncea.

On the various Cichoriaceae tested (Table 1) there was no sign of egg laying by the midge nor any sign of pustule development. On the other Compositae tested (Table 1) and on the 62 major cultivated plants the result was the same.

The C. schmidti strain used for testing originated from Greece. Of the various Australian and European forms of C. juncea exposed to it, the Australian narrow leaf form was the most heavily attacked. The Greek form was only second in attractiveness and the Aniane (S. France) form was very poorly attacked and on many occasions the pustules and the midge failed to develop. The Vieste (S.E. Italy) and other Australian forms of C. juncea were intermediate in attractiveness between Greek and Aniane forms.

## ACERIA CHONDRILLAE

This Eriophyid mite causes the flower and shoot buds of Chondrilla to produce a leafy gall within which all development of the mite takes place.

The genus Aceria has a large number of species occurring on plants of many different families. Any one species is generally considered to be restricted to a particular plant genus or species. A. Chondrillae has only been recorded from Chondrilla species.

The various Cichoriaceae and Compositae (Table 1) and the 62 major cultivated plants were all tested by attaching to them mature galls containing dispersing mites from C. juncea plants. There was no gall development on any plant except C. juncea and no living mites were found in buds of the test plants.

Strains of A. chondrillae from the Mediterranean were tested against the Australian forms of C. juncea. A strain from Dionyssos in Greece infested the most common Australian narrow leaf form better even than the Greek forms, but the Aniane (S. France) and Vieste (S.E. Italy) strains did not attack the Australian forms.

## DISCUSSION

The three insects and one mite whose specificity to Chondrilla has been tested had never been recorded on any other genera of plants except Chondrilla. There was therefore strong assumption of a high degree of specificity.

The testing undertaken has clearly demonstrated the extreme specificity of three of these organisms, Chondrillobium blattnyi, Aceria chondrillae and Cystiphora schmidti to Chondrilla. In the case of Uroleucon (Dactynotus) chondrillae a greater flexibility in host range was demonstrable. However, this aphid was restricted as far as breeding to the Crepidinae and can be considered to be restricted to Chondrilla

in the field. It was clear even from the laboratory results that it would not directly affect any cultivated plants, not even lettuce, the only commonly cultivated member of the Cichoriaceae in Australia.

Several other insects are recorded only on the plant genus Chondrilla. These are the two moths, the Tortricid, Oporopsamma wertheimsteini Rbl., and the Pyralid (Phyticid), Bradyrrhoa gilveolella Tr., the Buprestid, Sphenoptera foveola Gebl., and the Coccid, Neomargorodes chondrillae Ark. That so many arthropods should be specific to this plant is surprising. Two factors that may be relevant are the taxonomic isolation of Chondrilla in the tribe Crepidinae of the Cichoriaceae and that the Cichoriaceae all produce latex. Furthermore, markedly more copious quantities of latex are found within all the vegetative organs of Chondrilla than in other Cichoriaceae.

The strains of the organism tested have also been found to be partially specific to certain forms of C. juncea, being particularly well adapted to the form of the plant from which they originated. In general the Aniane (S. France) strains of organism did not readily attack the Chondrilla forms from Vieste (S. Italy), Greece and Australia The Vieste strain of U. chondrillae was well adapted to the Australian forms but this strain of C. blattnyi was not. The Greek strain of A. chondrillae was effective against the Australian narrow leaf form, attacking it more readily than the Greek plants on which it was found. Cystiphora schmidti is only found from the Eastern Mediterranean to Southern Russia. Only the Greek form was tested and found to attack all Australian forms readily.

Groves (personal communication) who has compared the various European forms of C. juncea with the Australian forms notes that both Vieste and certain of the Greek forms closely resemble morphologically the Australian forms of the weed, but that the Aniane and Western Mediterranean forms are distinctively different.

Such a high specialisation to particular geographical forms of this plant can be explained by the continual selection pressure imposed on the organisms by their host plant which, throughout its range has developed a large number of geographically separated apomictic clones. The development of these separate clones would facilitate the differentiation of parallel strains of the arthropod.

All four organisms are considered sufficiently specific, in their direct attack on the plant, to be used as biological control agents for C. juncea. So far, however, only C. schmidti and A. chondrillae have been introduced into Australia. The possibility that the two aphid species might serve as vectors of the viruses of lettuce, a plant which they probe but on which they do not breed requires further investigation before it can be decided whether or not they would be safe enough to introduce.

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Table 1. The list of Compositae that were tested with the four arthropods from Chondrilla juncea L.

| Composite plants tested | Uroleucon chondrillae | Chondrilobium blattnyi | Cystiphora schmidti | Aceria chondrillae |
|---|---|---|---|---|
| Liguliflorae | | | | |
| Cichoriaceae | | | | |
| Lactuca sativa L. | T.R.F. | T.R. | T. | T.F. |
| Cichorium endivia L. | | T.R. | T. | T.F. |
| Cichorium intybus L. | T.R. | | | |
| Taraxacum officinale Web. | T.R.F. | T.R. | T. | |
| Sonchus asper All. | T.R.F. | | | T.F. |
| Sonchus oleraceus L. | T.R.F. | T.R. | | |
| Sonchus arvensis L. | | | T. | |
| Crepis pulchra L. | T.R. | | | |
| Crepis taraxacifolia Thuill. | T.R. | T.R. | | |
| Reichardia picroides (L.)Roth. | T.R.F. | | | T.F. |
| Picris hieracioides L. | | | T. | |
| Urospermum dalechampii Desf. | T.R. | | T. | |
| Hypochoeris glabra L. | | T.R. | | |
| Hypochoeris radicata L. | | | T. | T.F. |
| Helminthia echioides Gaertn | T.R.F. | | T. | |
| Lagoseris sancta Schz. | T.R.F. | | | |
| Hieracium pilosella L. | T.R. | | | |
| Tragopogon sp. | T.R. | | | |
| Scolymus sp. | T.R. | | | |
| Scorzonera hispanica L. | | T.R. | | |
| Tubuliflorae | | | | |
| Heliantheae | | | | |
| Helianthus annuus L. | T. | T. | T. | T.F. |
| Helianthus tuberosa L. | E. | E. | T. | T.F. |
| Dahlia sp. | E. | T. | T. | T.F. |
| Zinnia sp. | E. | T. | T. | T.F. |
| Helenieae | | | | |
| Tagetes sp. | E. | E. | T. | T.F. |
| Anthemidae | | | | |
| Chrysanthemum sp. | E. | T. | T. | T.F. |
| Cynareae | | | | |
| Carthamus tinctorius L. | T. | T. | T. | T.F. |
| Cynara scolymus L. | E. | T. | T. | T.F. |

T = plant tested by placing arthropods directly on it.
E = plant exposed continuously to infested C. juncea in greenhouse.
R = rosette tested.
F = flower shoot tested.
Space = plant not tested.