

THE BIOLOGICAL CONTROL OF SKELETON WEED, *CHONDRILLA JUNCEA* L.
ENTOMOLOGICAL ASPECTS

L. CARESCHE

Introduction

Chondrilla juncea L. (fam. Compositae) is a plant of Southern Russian origin and is found in Europe, particularly in the Mediterranean climate areas.

It is a perennial with a rosette stage in the autumn and spring followed by a bushy flower shoot in summer. It can regenerate each year from a deep vertical rootstock.

C. juncea was introduced accidentally into Australia about 50 years ago and has become extremely noxious in wheat cultivation in the part of South-East Australia with a Mediterranean type climate. Control by chemical means has proved to be ineffective or too expensive and it was therefore decided to explore the possibilities of biological control. To this end, C.S.I.R.O., with a base at Montpellier, has for the last two years been making a research study of the plant in Mediterranean Europe.

In this report the entomological aspects of this research are discussed.

Insect fauna of *C. juncea*

More than 20 species of insects living on *C. juncea* have been recorded by various authors, notably by Russian entomologists who studied the insects of various Cichoriaceae, which in association with members of this plant sub-family produce rubber latex.

These insects comprise Lepidoptera feeding on the leaves and flowering shoots, beetle miners of the stems, Dipterous species which attack the flowers, seeds and leaves and Homoptera, notably aphids on different parts of the plant, and finally a gall-producing acarion.

However, many of these insect species, particularly the phyllophagous Lepidoptera, are too northern in distribution and have a too wide and suspect host range, e.g. *Haemassia renalis* Hubn., or, as is the case with the species in Russia, are too far from the present working

zone to be of interest at the present time.

The attention of the group has been concentrated to date on enemies of *C. juncea* which are most damaging to the plant in the zone within which work has been carried out for two years.

Working Methods

Preliminary surveys have been made to date in the Mediterranean climatic areas of Spain, France and Italy.

In addition, at chosen sites in France and Spain, an ecological survey has been conducted with periodic observations and censuses to follow the population changes of the insects on *C. juncea* in relation to the phenology and dynamics of the plant host.

At the same time there is underway in the laboratory the study of the biology, previously unknown, of the insects most important on *C. juncea*, together with a series of screening tests to verify their host-specificity and safety with regard to plants cultivated in Australia.

Of the plants cultivated in Australia, the lettuce (*Lactuca sativa* L.) is the most closely related to *C. juncea* and the insect species are first tested on this plant and only if they fail to attack it, further tests on a large number of other cultivated plants are begun. Tests are also being made on the Australian forms of *C. juncea*.

Insect enemies of *C. juncea* being studied

At present the two aphids, *Uroleucon chondrillae* Nev. and *Chondrillobium blattnyi* Pint., and an Eriophyid mite, *Aceria chondrillae* Can., are being studied and screened.

These three species have been recorded only from the genus *Chondrilla*, and especially from *C. juncea*. They exist in all zones which the group has surveyed. Biological details concerning these species are as follows:-

Uroleucon chondrillae Nev. (Aphididae, s. fam. Dactynotinae)

This is a relatively large, brown, robust aphid which lives and feeds on all the green parts of the plant but prefers the growing flower shoot and floral buds. It is a monoecious species apparently specific to *Chondrilla* although similar closely related species occur on a number of other Cichoriaceae (*Sonchus*, *Cichorium*, *Hieracium*, etc.).

Sexual reproduction occurs just before winter, males being uncommon, and eggs are laid mainly on the leaves of the rosettes. Asexual reproduction continues in favoured situations as well. From spring to autumn multiplication is parthenogenetic with a marked decrease during the hottest and driest period of the year. Aphidid and Aphelinid parasites and predators, mainly Syrphidae, also play a role in this reduction in numbers. Fecundity of this aphid is not high but, nevertheless, in nature important infestations occur on the flowering shoots of *C. juncea*, which the plant supports easily and infestations have to be extremely heavy to damage the plant. These heavy infestations have yet to be observed in the field.

Host plant tests have shown that the French strain of *U. chondrillae* shows a certain reluctance to live on the Australian narrow-leaved *Chondrilla* form. Nevertheless, this aphid lives perfectly well on *Chondrilla prenanthoides* and has been reared in the laboratory on *Sonchus asper*. It feeds and can moult on lettuce (*Lactuca sativa*) but does not reproduce and it has never been recorded, as far as is known, on this plant. As regards specificity, this aphid may still be of some interest for the control of *C. juncea*.

If *U. chondrillae* were introduced into Australia its possible effect on *Chondrilla* would seem to depend principally on climatic factors, temperatures higher than those in Europe could reduce population increase but could also induce more continuous parthenogenesis etc., and on the complex of natural enemies present in Australia.

Even under optimum natural conditions only a weakening of the plant could be expected but this would add to the damage done by other organisms attacking *Chondrilla* and would then help in controlling this weed.

Chondrillobium blattnyi Pint. (Aphididae, s. fam. Myzinae)

This is a pale-green, flattened, soft-bodied aphid which is found most often feeding on the underside of the rosette leaves of *C. juncea*. Although sexual reproduction may also occur the only adults that have been found so far are parthenogenetic females and they reproduce asexually throughout the year.

It appears to prefer a lower temperature and a higher humidity than *U. chondrillae*. It has a high fecundity and rapidly colonises the rosettes of *C. juncea*. Under laboratory conditions it can cause the rapid death of

rosettes. However, under natural conditions it is found infrequently and at rather low population levels and because of this its natural enemies are almost unknown.

It is monoecious and apparently specific to *Chondrilla*, has never been recorded on any other host and it refuses to feed on *Lactuca*.

This aphid is an interesting enemy of *C. juncea* both because of its specificity and because of its destructive action on the rosettes but a more profound study would be needed to indicate whether it could serve as a biological control agent in Australia.

Aceria chondrillae Can. (Eriophyidae)

This minute, pale orange, Eriophyid mite lives essentially at the expense of the flowering buds and flowers of *C. juncea*, which are transformed into leafy galls. These serve as protected situations within which further multiplication of the mite occurs.

This species overwinters in the heart of the rosettes but does not reproduce and the population declines gradually to low levels during the winter. When the plant produces the flowering shoot, the surviving females infest the buds progressively, provoking the formation of galls within which reproduction commences actively again. Multiplication and dissemination of the Eriophyid on its plant host continue rapidly until the end of the vegetative growth of the flowering shoot. When the new regenerating rosettes appear, the Eriophyids infest them to overwinter. Desiccation of the old galls on the flowering shoot forces the Eriophyid to leave them for new rosettes. The reproductive capacity of this Eriophyid is enormous and the mite is easily distributed by wind. It has to date been recorded in all the climatic regions where *Chondrilla* is found.

A. chondrillae can inhibit the development of *C. juncea* which takes on a stunted, ragged look and, most important, the mite reduces and suppresses seed-production.

To date no predators or parasites have been observed on this Eriophyid although certain predacious mites, in particular, could affect its population.

A. chondrillae has no known hosts other than *Chondrilla* species and all attempts to infest *Lactuca* have

failed. As regards biological control, *A. chondrillae* would not be of radical importance to *C. juncea*, but it could contribute considerably to the limitation of the propagation potential of this noxious plant from its natural reservoirs in uncultivated situations.

Other insect species

Other insect species have been found on *C. juncea*. They are, notably *Tephritis rasa* Seguy (Tephritidae) and a Cecidomyid, which, without doubt, belongs to the genus *Dasyneura* which lives within the capitula, also two species of Agromyzid flies which mine the leaves of the rosette and of the flowering shoot, respectively. Although these insects do not, a priori, seem to be of much interest as biological control agents, it is intended to examine their value more closely.

Discussion and Conclusion

It should be realised that the arthropods that have been considered above, even the Eriophyid, are unlikely to destroy or to reduce *C. juncea* to an unimportant commensal of wheat in Australia. At the very most, perhaps one could hope that the *Aceria*, possibly aided by the two aphids, could slow down the spread of the plant and in certain cases produce a regression of it.

It is, therefore, important, without renouncing the use of the above species, to search for other enemies of the weed with a sufficiently restricted host range.

Three species of insects exist in Russia which attack the basal part of the flowering shoot and the upper part of the rootstock of this plant and damage it badly. They are *Bradyrrhoa gilveolella* Tr. (Lepidoptera, Phycitidae), *Oporopsamma wertheimsteini* Rbl. (Lepidoptera, Tortricidae) and *Sphenoptera foveola* Gbl. (Coleoptera, Buprestidae) (Emel'yanova *et al*, 1932; Dirsh, 1933; Kozulina & Rudakova, 1932). Our intention is to obtain living specimens of these insects and to study them with regard to their possible use as biological control agents against *C. juncea*. Also recorded on *Chondrilla* in Eastern Europe are two gall midges (*Cystiphora* sp. and *Laubertia schmidti* Low) which may also be of interest.

With the many uncertainties, in particular the differences in climate between the original home of these species and that of the *Chondrilla* areas of Australia, it is not possible to make more than a tentative appraisal.

Nevertheless, even if these insects successfully maintain themselves in Australia, it seems doubtful that they could completely solve the *Chondrilla* problem.

As this plant regenerates from its rootstock and continues to do so if the root is not killed or exhausted, either an organism which completely destroys the tap root is required or one which destroys repeatedly the rosette and flower shoot until the store of material in the root is exhausted. At the moment no insect species is known satisfactorily to fulfil these requirements. If none is found during forthcoming surveys of other parts of the range of *C. juncea*, one can pose the question whether it would not be worthwhile to extend the research to interesting insect species which occur on the Cichoriaceae as a whole and which live in other regions of the world outside the original distribution of *C. juncea*.

References

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