

## Additional Investigation of *Schinia cognata* Fr. (Lepidoptera: Noctuidae) as a Potential Bioagent for Control of *Chondrilla juncea* L. (Asteraceae)

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### SUMMARY

*Chondrilla juncea* L. is a tap rooted perennial plant accidentally introduced in the United States from Europe in the 1870s which has turned into a serious invader of pastures and crop lands. A lack of its natural enemies was one of the main reasons for its fast distribution in Australia and the USA. As *Ch. juncea* L. origins from the Balkans, investigation of natural enemies of the weed was conducted in Bulgaria in 2000-2007. Among all recovered insects, the moth *Schinia cognata* Fr. (Lepidoptera: Noctuidae) was considered as the most promising candidate for bioagent to control *Ch. juncea* L. This paper focuses on studies of its population dynamics and host testing. The moth develops two generations per year and the feeding of its larvae is restricted to *Ch. juncea* L.

**Keywords:** Biological weed control; *Chondrilla juncea* L.; *Schinia cognata* Fr.; Host testing

### INTRODUCTION

The use of bioagents for weed control has been practiced for more than 100 years (Gassmann, 1996). Conventional biological control that uses insects and in some cases pathogens is traditionally applied in countries like Australia, the United States of America, New Zealand, South Africa, Kanada (Julien and White, 1997). Nowadays, interest in biological control is increasing mainly due to the negative effect of chemical control on the environment and because it has been included as an important element in strategies for weed control. Programs for biological weed control have been developed in more than 50 countries and more than 41 weed species have been successfully controlled (DeLoach, 1991). The first effective program for control of *Chondrilla juncea* was developed and implemented in Australia in 1960. The density of the weed significantly declined as a result of an introduction of three biological agents from Italy and Turkey – a rust (*Puccinia chondrillina* Bubak and Sud), a gall midge (*Cystiphora schmidti* Rubsaamen (Diptera: Cecidomiidae)), and a gall mite (*Aceria chondrillae* Canestrini) (Cullen, 1978). However, those agents could not be established in cooler regions of the United States or were ineffective. In 1995, a program was implemented to research rush skeletonweed's native Eurasia for more effective biocontrol agents for those cooler climates (Markin and Quimby 1997). Within the program a preliminary survey was conducted to locate populations of *Ch. juncea* in Bulgaria and to determine possible agents of biocontrol (Lecheva and Stantcheva, 2003). The investigation indicates that *Ch. juncea* is widespread in Bulgaria mainly in disturbed areas and on roadsides. It also occurs in orchards, vineyards, rose fields and wheat plots. It was found that the agents established in Australia and North America as a part of the program for biological control are also associated with *Ch. juncea* in Bulgaria. Additionally, leaf-feeding beetles and moths, root-miners, and seed-feeding flies and moths were also recorded (Lecheva and Karova, 2005). Among the recorded 51 insects, the most promising candidate for bioagent to be introduced in the United States is the noctuid moth *Schinia cognata* (Lepidoptera: Noctuidae)

(Karova, 2007). The investigations showed its wide distribution throughout the country, high population density and restricted host specificity.

## MATERIAL AND METHODS

Observations concerning the dynamics of population density of *Sch. cognata* were carried out in a *Ch. juncea* population on 6 ha of uncultivated area located near the town of Plovdiv. Investigations were performed during active vegetation of the host plant from April until October. The method of “sweeping by entomological net” and visual methods (examining leaves, branches, flower buds and flowers of host plants individually) were primarily used. Observations were repeated every 10-14 days.

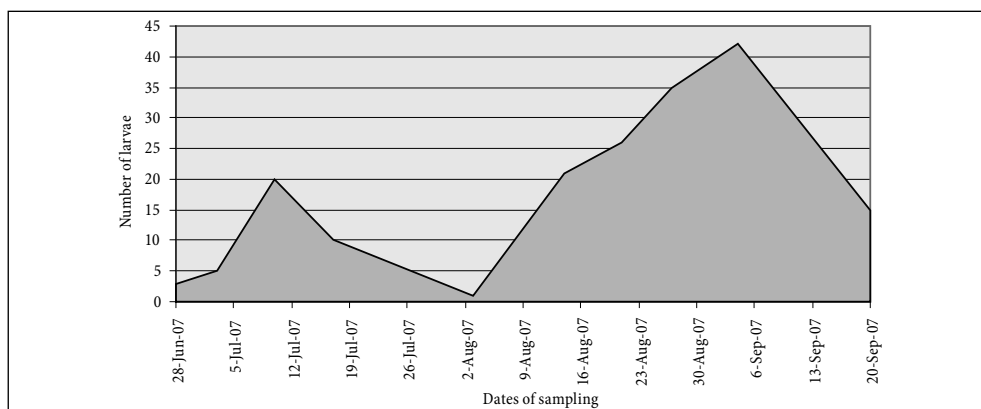
Host specificity tests were conducted under laboratory conditions using folio isolators. The test was carried out at the Biological Control Laboratory of the Department of Entomology, Faculty of Plant Protection and Agroecology, University of Agriculture in Plovdiv. The test was conducted in 2 versions, 10 replications each (first version – 10 plants of *Ch. juncea*, and second one – 10 plants of *Cichorium intybus* L.). *C. intybus* is one of the most common plants in *Ch. juncea* populations. In July 2007, some *Ch. juncea* and *C. intybus* plants were picked up from natural populations, planted in pots and grown under laboratory conditions. One folio isolator was placed on each plant and one 3<sup>rd</sup> instar larva into each isolator, respectively. Feeding and behavior of the larvae were observed daily.

## RESULTS AND DISCUSSION

### I. Population density, 2007

Our studies in the previous years had shown that *Sch. cognata* developed two generations per year that overlapped, with active flight in July and August, respectively (Lecheva and Karova, 2005). In 2007, the first larvae of *Sch. cognata* (first generation) were present at the beginning of July – on July 3<sup>rd</sup>, 5 larvae were found in 100 sweepings by entomological net (Fig. 1). A maximum number of larvae from the first generation was reported on July 10<sup>th</sup> – 20 larvae in 100 sweepings by entomological net. All collected larvae of the first generation pupated normally despite the extremely high temperatures of July 2007.

The first larvae of the second generation appeared on August 3<sup>rd</sup>. September turned out to be unusually favourable for the development of *Sch. cognata* larvae. From the beginning of the month until September 20<sup>th</sup>, high



**Figure 1.** Dynamics of population density of *Schinia cognata* larvae in *Chondrilla juncea* population in the region of Plovdiv, 2007

**Slika 1.** Dinamika gustine populacije larvi *Schinia cognata* u populaciji *Chondrilla juncea* u području Plovdiva, 2007

density of caterpillars was recorded. A maximum number of larvae from the second generation was reported on September 4<sup>th</sup>, when 42 caterpillars were encountered. Larval density decreased after September 20<sup>th</sup> (Figure 1).

## II. Host testing

Larvae of *Sch. cognata* feed on flower buds, flowers and seed heads of *Ch. juncea*. After the hatching of eggs, larvae of the first two instars feed inside the flower bud, flower or seed head, after the second instar they get out, move to another one and consume it. If density is high, they may totally destroy the generative parts of the plant.

Studies on host specificity are a key element of a biological control program as it is very important that the bioagent should not turn a pest itself. The bioagents should develop normally only on the target plant or some closely related species which is also a weed or has no economic value.

The first impression regarding host specificity comes from visual examination in a natural ecosystem and then it has to be confirmed by laboratory testing.

Field surveys showed that larvae were present and feeding only on *C. juncea* plants. They were not observed on the surrounding species such as *C. intybus*, *Matricaria chamomilla* L., *Amaranthus retroflexus* L., *Achillea millefolium* L., *Chenopodium album* L., *Centaurea cyanus* L. or *Centaurea solstitialis* L.

After visual examination of the behavior and feeding of *Sch. cognata* larvae in 2004-2005 in the field, experiments were conducted under laboratory conditions with five test plants (choice trials and no-choice trials) – *Ch. juncea*, *C. intybus*, *Lactuca sativa*, *Lactuca seriola* and *Sonchus oleraceus*, placed into Petri dishes and plastic cages, and it was found that the larvae are specific to *Ch. juncea* (Karova, 2007). In 2007, another experiment was carried out using isolators,. In all 10 replications with *Ch. juncea* as the host plant, each larva was feeding as usual and developed normally into a pupa, and adults emerged.

In all 10 replications in which *C. intybus* was offered as a feeding plant not even one larva did feed on the plant. All larvae were moving around for the first 2 days but after that they began to die. Seven days after the beginning of experiment all larvae were dead because they refused to feed even though sufficient food was provided.

## CONCLUSIONS

Due to its high feeding potential, easy laboratory rearing, wide distribution, high population density in the stands of the host plant and its highly restricted feeding specificity, the moth *S. cognata* has been selected as a potential agent for biological control of *Ch. juncea*. Prior to its introduction in the U.S., laboratory testing of the feeding specificity of *Sch. cognata* in 2007 again clearly demonstrated that the moth was highly specific to *C. juncea*. The larvae develop normally and pupate only in the presence of *Ch. juncea* as their feeding plant.

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### **Dopunsko ispitivanje vrste *Schinia cognata* Fr. (Lepidoptera: Noctuidae) kao potencijalnog bioagensa u suzbijanju *Chondrilla juncea* L. (Asteraceae)**

#### **REZIME**

*Chondrilla juncea* L. je višegodišnja biljka sa izraženim primarnim korenom koja je slučajno bila uneta u Sjedinjene Države iz Evrope tokom 1870-ih godina i koja se zatim pretvorila u ozbiljnu invazivnu vrstu pašnjaka i polja pod usevima. Nedostatak prirodnog neprijatelja bio je glavni razlog njenog brzog širenja u Australiji i SAD. Kako je *Ch. juncea* L. poreklom sa Balkana, sprovedeno je istraživanje prirodnih neprijatelja ovog korova u Bugarskoj tokom 2000-2007. Među prikupljenim insektima, vrsta moljca *Schinia cognata* Fr. (Lepidoptera: Noctuidae) je izdvojena kao mogući bioagens u suzbijanju *Ch. juncea* L. Ovaj rad se zasniva na proučavanju populacione dinamike ove vrste moljca i ispitivanju biljke domaćina. Moljac daje dve generacije potomstva u godini, a njegove larve se hrane isključivo na biljci *Ch. juncea* L.

**Cljučne reči:** Biološko suzbijanje korova; *Chondrilla juncea* L.; *Schinia cognata* Fr.; ispitivanje biljke domaćina

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