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THE OCCURRENCE OF *HYPERA RUMICIS* L. (*COL., CURCULIONIDAE*) ON *RUMEX CONFERTUS* WILLD. AS AN INTERESTING OPTION FOR BIOLOGICAL WEED POPULATION CONTROL

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Abstract: Biological methods of weed control are alternative to chemical treatments. Biological techniques are used where no possibility for chemical spraying occurs. *Rumex confertus* Willd. is an example of a plant-eater which is potentially more important than chemical compounds.
The objective of the study was to evaluate population dynamics and the development of *Hypera rumicis* L. (*Coleoptera, Cucurlionidae*) on *Rumex confertus* Willd. as well as to determine effects of the injuries on growth of a plant.

Key words: biological control, *Rumex confertus* Willd., biological agent, *Hypera rumicis* L., weeds

I. INTRODUCTION

Rumex confertus Willd. is a plant developing intensely in the country over the recent years. This weed can produce large numbers of seeds, even as much as 40,000, once or twice a year (Cavers and Harper 1964).

However, it is not a domestic plant of Poland, being most frequently found rather in the west and east Siberia, the Far East and some regions of mid- and Minor Asia. It can be found also on the Balkan Peninsula (Zemlinskij 1958), showing a strong expansion from the East to the West (Żukowski 1960; Kornaś et al. 1959).

A relatively high content of oxalate acid makes it an attractive fodder for some animals, while higher amounts can cause even lethal poisoning.

Chemical treatment is the most commonly used measure for the control of this weed. It is highly efficient, but on the other hand it can create resistant varieties impossible to control with certain chemicals, which are being used perhaps too often (Boczek 1996; Jędruszczak 1998; Marocchi 1989). Environmental pollution is another important issue, therefore any unjustified use of chemical sprays cannot be accepted. However, the finding and using natural enemies of the pests has been recently considered as an increasingly important solution (Kovalev and Zaitzev 1996; Watson and Wymore 1989).

Such insects as *Pegomya* spp., *Hypera* spp., *Mamestra* spp., are well known to fight unwanted weeds very efficiently (Spencer 1980).

In contrary to chemical treatments, biological methods are not used on a large scale, but certainly they can play an important role in the world system of plant protection (Labrada 1996).

II. METHODS AND AREA OF THE STUDIES

The experiments were carried out in 1997–1999 at *Rumex confertus* Willd. natural habitat conditions near Bydgoszcz-Fordon and Toruń at the Vistula River over the whole vegetation period.

The field experiments were divided into several group projects:

1. sampling with a scoop. Studies allowing evaluating the composition and development of insect population were carried out over the whole experimental period from spring to autumn. The catching was performed once a week in 1998 and 1999, while in 1997 it was done once a fortnight. Each time 25 full strikes with entomological scoop were done (one full strike per one leaf rosette tuft), what resulted in 25 plants tested.
2. insects were collected for further experiments. The material collected in this way was analysed in the laboratory and used for rearing. The sampling took place in 1997 and 1998. Observations of biology, the occurrence of insect and other species injuring the plants have been performed over the whole plant vegetation period (May–September). Moreover, development stages were determined, what gave a picture of the number of generations over vegetation.
3. impact of *Hypera rumicis* L. feeding on the plant abilities to produce fruits were evaluated in 1998 and 1999. Ten plants were used for this purpose at the beginning of vegetation. Changes undergoing on those weeds were evaluated once a week.

   A five-degree-infection scale was used, where:

   0° – no infection,

   1° – up to 10% injured inflorescence shoots,

   2° – 11%–20% injured inflorescence shoots,

   3° – 21%–30% injured inflorescence shoots,

   4° – 31%–50% injured inflorescence shoots,

   5° – more than 51% injured inflorescence shoots,

The Toruń experiments were performed at the Vistula River according to point 1, as described for the Bydgoszcz part of the study. Scooping, as well as other observations, was done over the whole vegetation period in 1998 and 1999 in ten-day intervals.

Laboratory experiments were carried out in 1997 and 1998 in the Department of Applied Entomology, UTA, Bydgoszcz.

The following assays were carried out in the laboratory:

1. surface of the consumed leaves over the 24 h test period with the feeding of the *Hypera rumicis* L. adults. The experiment was carried out in 4 replications on Petri dishes containing 10 beetles each. The same leaf without insects was the control. A scanner was used in estimation the size of the consumed leaves.

III. RESULTS

Hypera rumicis L. is usually about 4.0–5.5 mm long. Small scales cover its body, what is its characteristic feature. A V-shaped band can be seen on the rear covers of the body.

Considering the appearance of adults and larvae in the second part of June near Bydgoszcz it can be concluded that the species under study had only one generation over vegetation period. Analyses of population dynamics (Fig. 1) have demonstrated an extreme appearance of the weevil in May and at the beginning of June in 1998. It was an over-wintering generation, which left its shelters and started feeding. Round holes on leaves were found as an effect of adult feeding. In contrary to the larvae occurrence, either no trace of them was noted or they occurred only rarely on the inflorescence. In 1997 and 1999 the

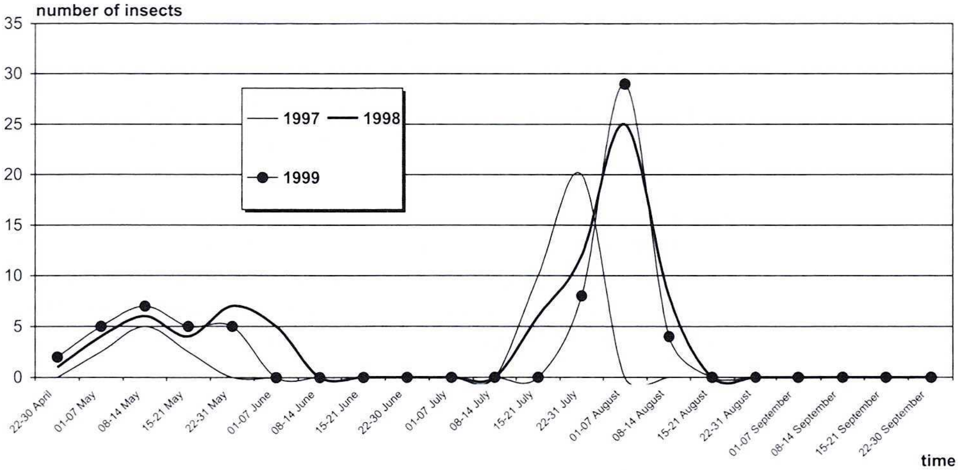

Fig. 1. Dynamics of *Hypera rumicis* L. population near Bydgoszcz

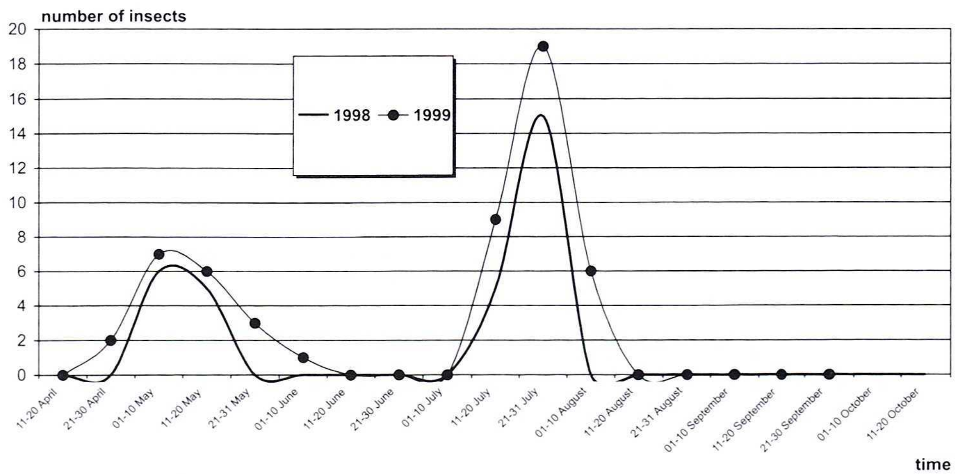

Fig. 2. Dynamics of *Hypera rumicis* L. population near Toruń

highest number of the insects caught was noted in half-May (5 and 7 specimen, respectively) and in 1998 at the end of May (7 specimen).

In the consequence of feeding and the larvae growth a first generation of beetles was observed. This generation appeared on the leaves in mid-July. Of course, it was more numerous than the former on. Feeding of larvae was not possible on inflorescence shoots due to the their lack at the beginning of July Consequently the deficiency of nourishing material caused that the weevil was not able to develop the second generation. At the end of August and beginning of September the imagines have started over-wintering.

The occurrence of one *Hypera rumicis* L. generation during one vegetation period near Toruń is shown on Fig. 2. The insects were leaving their winter shelters predominantly in May. Therefore their larva development period occurred at the most in June and also in part in July. After pupation in the second part of July, imagines of the first generation have appeared.

In relation to the same generation the species was somewhat more numerous near Bydgoszcz, however the period in which the insects appeared on the plants was the same.

Inflorescence shoot injures are shown on Fig. 3. One insect species directly injuring fruit ovaries were noted. It was *Hypera rumicis* L. The additional species, without biological control significance, appeared *Aphis fabae* Scop. The larvae of the first species were feeding on fruits damaging them completely, while imagines were injuring the leaves. Both adult specimen and the larvae of the aphid were sap sucking from the plants. It was observed that *Aphis fabae* Scop. plants were settling inflorescence shoots was observed in the second half of May up to the first half of July. However, the time of occurrence of the *Hypera rumicis* L. larvae was by far shorter. *Hypera rumicis* L. feeding on mossy sorrel has affected generative organs of the weed in part, what is shown on Fig. 4. The evaluation was done on 26th June, 1998 and 30th June 1999 just before drying out of the shoots caused not by the insect feeding but by the physiology of the plant itself. The degree of infestation in both years seemed to be similar. The highest number of the infested shoots was 3° (one-third of the

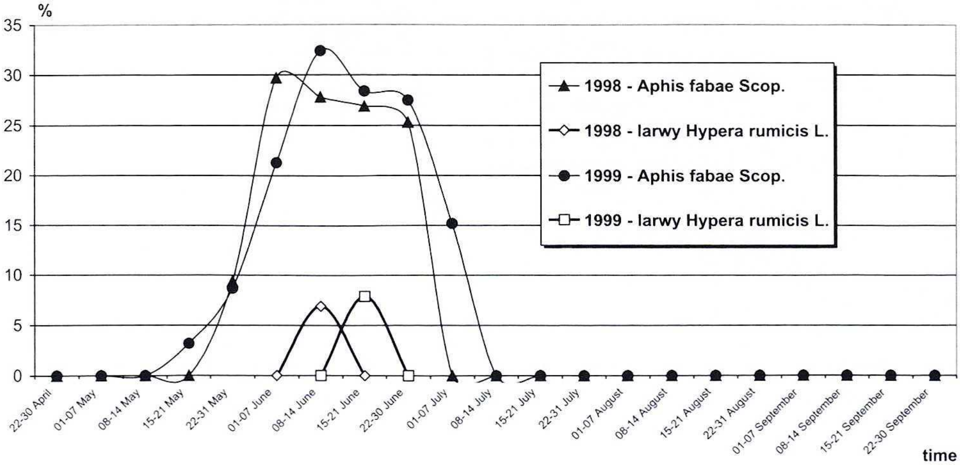

Fig. 3. Inflorescence with insects

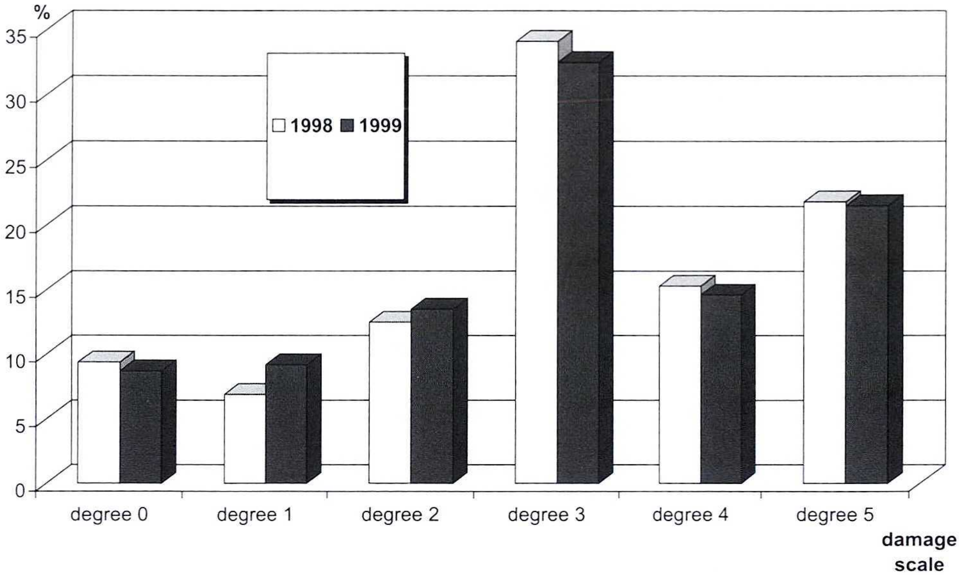

Fig. 4. Inflorescence injuries caused by insects

plants under study). About 20% shoots were evaluated as infested at 5°. It was interesting to note that only about 10% plants were not infested at all.

The *Hypera rumicis* L. larvae inhabited the plant at mid-June (1998) and at the second decade of the month (1999). One inflorescence shoot hosted from 27 to 41 larvae (1998). The average for 1999 was 38 larvae. A single inflorescence shoot consisted of ramification of the I and II rank. The plant was developing seeds not earlier than at the second ramification. Every ramification contained about 132 fruit. The total number of single organs producing seeds averaged 19. However, the whole plant developed not more than one shoot. Usually 13 inflorescence shoots were observed.

Therefore:

$132 \times 19 \times 13 = 32{,}604$ fruit per a plant

About one-third of the formed fruits was injured by insects in both 1998 and 1999. Therefore, the abilities of the plant to spread around were limited to a large extent. Sometimes *Apion miniatum* Germ., *Hypera rumicis* L. imagines and *Gastroidea* spp. Larvae were also observed on the inflorescence shoots.

The area of leaves consumed by adult specimen of *Hypera rumicis* L. was

Table 1

Percent of injured fruit

Number of observed plants	Percent of injured fruit in 1998	Percent of injured fruit in 1999
1	38	39
2	41	51
3	22	28
4	31	45
5	25	28
6	41	31
7	27	34
8	35	32
9	27	28
10	39	36
Mean	32.6	35.2

measured in laboratory. Measurements were done in relation to the over-wintering and successive generations. The results corrected for evaporation from leaves are given below:

- over-wintering generation – 142.3 mm^2/24 h per one specimen,
- successive generation (I) – 123.5 mm^2/24 h per one specimen.

A higher weight of leaves consumed by the weevil of the over-wintering generation was probably caused by starvation of the beetles over the winter period. It seems very possible that the insects were forced to supplement their energetic resources more intensely than the following generations.

IV. DISCUSSION

Damaging generative organs responsible for reproduction of the plant was an important destructive factor in relation to the weed. This way of feeding is typical for *Hypera rumicis* L. The feeding caused a reduction in the seed yield. The weeds were injured by adult specimen, but first of all by the larvae damaging fruit ovaries. The whole mossy sorrel plant produces up to 30,000 seeds. In our study more than 30% of them were injured directly by *Hypera rumicis* L. The infected plants were characterised by lower biomass, and a lower structure, but first of all by a disability of producing generative organs, which were a decisive factor. DeGregorio et al. (1991) and DeGregorio and Ashley (1988) have stated that the feeding of this insect species has caused a loss of the colour of the green tissue of the plant in the USA.

Natural methods of weed control can be by far more effective toward a certain group of unwanted plants and they can be also cheaper. Inman (1971) have stated that 43% of plants attacked by rust re-grew the next spring. Nevertheless, as much as 95% plants have developed leaf rosettes after the treatment with chemicals.

V. CONCLUSIONS

1. Generative organs of the weed under study were injured by *Hypera rumicis* L. Its larvae fed on the inflorescence.
2. More than 30% of all the fruit developed by plants were injured mainly by *Hypera rumicis* L., what significantly limited the spreading out of the weed.
3. The number of insect generations settling the mossy sorrel near Bydgoszcz (1997–1999) and Toruń (1998–1999) was the same.
4. The results have indicated some possibilities for the use of *Hypera rumicis* L. for biological control of *Rumex confertus* Willd.

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WYSTĘPOWANIE *HYPERA RUMICIS* L. (*COL., CURCULIONIDAE*) NA *RUMEX CONFERTUS* WILLD. JAKO INTERESUJĄCEGO PRZEDSTAWICIELA DO BIOLOGICZNEJ REGULACJI CHWASTU

STRESZCZENIE

Chwasty są organizmami szkodliwymi, związanymi z działalnością człowieka, zatem istnieje potrzeba walki z nimi.

Środki chemiczne najczęściej stosowane do walki z chwastami są często mało selektywne, skażają środowisko oraz szybko stają się nieskuteczne, ponieważ organizmy nabywają odporności.

Metody biologiczne wydają się pewnym rozwiązaniem tego problemu. Spotkały się one ze szczególnym zainteresowaniem badaczy w odniesieniu do roślin zasiedlających tereny przyrzeczne.

Hypera rumicis L. to gatunek mogący odegrać pewną rolę w biologicznej walce z tym chwastem, ze względu na niszczenie części generatywnej rośliny. Badania pokazały, że owad ten może być potencjalnym regulatorem populacji zachwaszczenia spowodowanego przez szczaw omszony.