

Rosy rustic moth as a hop pest in the Hallertau: History and current situation

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Abstract: Die Markeule *Hydraecia micacea* (Lepidoptera: Noctuidae) als Hopfenschädling: Geschichte und ein rezenter Ausbruch in der Hallertau.

Hydraecia micacea (ESPER, 1789) wurde als Schädling des Kulturhopfens erstmals im Jahr 1910 aus dem böhmischen Dorf Michelob beschrieben. Seitdem kam es in einigen europäischen Anbaubereichen zu sporadischen Ausbrüchen. In der Hallertau wurde von 1969–70 und 1980–81 von bedeutenden Schäden durch die Markeule an Hopfen berichtet. Von 2012 bis 2014 kam es in der Hallertau erneut zu einer Befallsspitze, die die Hopfenbauern in der Region völlig überraschte. Es wurde schnell klar, dass signifikanter Markeulenbefall immer mit dem Auftreten von Süßgräsern (Poaceae) im Hopfenbestand verbunden war, da die Markeule ihre Eier in die Blattscheiden von Gräsern ablegt. Besonders die Gemeine Quecke *Elymus repens* sowie die Hühnerhirse *Echinochloa crus-galli* sind bevorzugte Eiablagepflanzen, von denen dann im nach der Überwinterung der Eier im Frühjahr die jungen Larven auf den Hopfen überwandern und dort beginnen, die jungen Triebe zu minieren. Später wandern die deutlich größeren L3- und L4-Larven in den Boden ab und fressen dort an Wurzeln und der Stängelbasis. Eine effiziente Eindämmung des Befalls von *H. micacea* im Hopfen ist daher nur über die Verhinderung der Verunkrautung mit Poaceen in den Fahrgassen zu erreichen und der Einsatz von Bodeninsektiziden stellt eher Aktionismus dar. Ein dreijähriges Monitoring (2013–2015) der Nachtfalter mit einer Lichtfalle ergab, dass in der Hallertau nur eine Generation pro Jahr auftritt und die Flugzeit der Falter von Mitte Juli bis Anfang Oktober reicht.

Key Words: *Hydraecia micacea*, Noctuidae, control, management, *Elymus repens*

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Introduction

The Rosy Rustic Moth, *Hydraecia micacea* (ESPER, 1789), a noctuid (Fig. 1), is an occasional pest of several cultivated crops in Europe. Its primary habitat is wetlands. The polyphagous stem-boring larvae attack a wide range of host plants, including corn, potatoes, tomatoes, cereals, onions, strawberries and hops. The species also infests a number of weeds, especially couch grass *Elymus repens*, docks and sorrels *Rumex* spp. and lambsquarter *Chenopodium album* (WEIHRAUCH & FISHER 2009). A native of the northern Palaearctic, *H. micacea* has a distribution extending from the polar circle southward to Spain and eastwards to Japan. In the early 1900s the species was introduced to eastern Canada and to the United States.

From 2012 to 2014 an infestation peak of *H. micacea* occurred in the Hallertau that took the growers of the region completely by surprise as most had not been familiar with this pest before. The uncertainty among growers on how to cope with the problem was high and so this outbreak was taken as an opportunity to further investigate the life cycle and other aspects of the species' biology and the actual damage done to hops to give recommendations for reasonable control measures.

Materials and Methods

A comprehensive literature search and evaluation was performed covering both historical and recent outbreaks of *Hydraecia micacea* and their damage to hops in all the European growing regions.



Fig. 1. Rosy Rustic Moth, *Hydraecia micacea* (ESPER, 1789), left: Larva, right: adult moth.

Investigations concerning the biology and life cycle of *H. micacea* were performed from 2013 to 2015 in several hop fields in the Hallertau growing region, from where significant damage due to *H. micacea* infestation had been reported by growers. Selected field sites belonging to six farms were visited and the level of *H. micacea* infestation was assessed by counting infested shoots, evident by “hanging heads”, larval entrance holes and wilting symptoms. Infested shoots were removed, bisected vertically with a utility knife and examined for the presence of burrowing larvae. In one hop field that probably exhibited the highest degree of infestation during April and May 2013, a plexiglass cross window light trap was set up from 6th August to 5th October 2013, from 25th June to 29th September 2014 and from 28th June to 30th September 2015 for the monitoring of adult moths.

Tentative field efficacy trials to assess chemical control measures were set up at two sites (Eschelbach and Eja) in 2013 and at three sites (Rudertshausen [2] and Niederulrain) in 2014. The tested variants included a.i. chlorantraniliprole, spinosad, imidacloprid, and lambda-cyhalothrin. The single plot size of these small-scale trials was seven crowns, replicated four times, respectively. Pesticides were applied by soil drench application using 200 ml aqueous solutions of these products per single crown.

Review of *Hydraecia micacea* outbreaks in European hop-growing regions

An outbreak of *Hydraecia micacea* damaging cultivated hops was first reported in 1904 from the Bohemian village of Michelob in the Saaz growing region (GÜNDEL 1904). Since that time, significant damage by *H. micacea* has been reported from a total of four European hop growing regions. These peaks of damage have however only occurred sporadically and usually lasted for a period of only two to three years. In Saaz, or today's Žatec in the Czech Republic, significant damage by *H. micacea* was

reported from 1910–11 (REMISCH 1910; TÖLG 1911), from 1954–56 (KŘÍŽ 1976), and from 1996–98 (ŠEDIVÝ & al. 2005). In the United Kingdom, *H. micacea* was first recorded as a pest of hops in 1927 (THEOBALD 1928) and noteworthy infestations occurred in Kent from 1968–72 (FRENCH & al. 1973). In the Slovenian Savinja Valley, *H. micacea* was recorded as infesting hops from 1982–85 and from 1992–94 (ŽOLNIR & CARNELUTTI 1995). In the Hallertau region of Bavaria, Germany, significant *H. micacea* damage to hops was recorded from 1969–70 (SCHERNEY 1970; LIEBL 1971), from 1980–81 (RIEHM 1983) and again starting in 2012. This recent outbreak lasted until 2014. By the 2015 vegetation period, the pest had again virtually vanished from hop fields of the region. There are no other reports of severe *H. micacea* outbreaks in hops available from Europe or from other hop-growing regions of the world.

Phenology

The first significant damage by larvae in the current study was reported on 2nd May 2013 near Eja, and a subsequent check of this field accounted for an infestation of at least one shoot on approximately 30 % of crowns on 7th May. In an untreated control plot, larval activity was observed until mid-July, when pupation began. As the light trap was only set up on 5th August in 2013, the onset of the flight period in that year was not recorded, and the first catch on 6th August already yielded the maximum catch rate of 55 moths in one night. In 2014 however, the first moth was recorded in the light trap on 21st July, and in 2015 on 31st July. The end of annual flight period of moths was recorded on 29th September 2013, 17th September 2014 and 23rd September 2015 respectively. The total annual catch in the light trap was 576 moths in 2013 (max. 55 moths on 6th August), 94 moths in 2014 (max. 7 moths on 20th August), and 17 moths in 2015 (max. 4 moths on 12th August).

Control and management

Four of the five small-scale field trials laid out to assess the efficacy of chemical control did not yield any results because the fields chosen for the trials, which had in the previous year been severely infested, did not show any infestation by *H. micacea* at all – this especially applies to all trials laid out in 2014. Only one tentative trial conducted in 2013 exhibited infestation rates allowing an assessment. Of the six pesticides tested, chlorantraniliprole had the best efficacy with zero infestation for a period of four weeks after application, compared to 17.9 % infested crowns in the untreated control. For all other tested pesticides a certain degree of infestation still occurred.

During field work in infested hop fields it however soon became clear that hot spots of *H. micacea* infestation were always connected with the occurrence of true grasses (Poaceae) in the hop gardens. Especially couch grass *Elymus repens* and, of less importance, cocksbur grass *Echinochloa crus-galli* had usually been abundant weeds in those fields with heavy infestation in 2012 and 2013. After their eradication in 2013 and 2014 the infestation level in most fields, within the entire growing region dropped dramatically.

Discussion

After the sudden onset of *H. micacea* infestations in 2012 and especially after the continuation of the outbreak in 2013, hop growers in the Hallertau demanded the official implementation of an emergency permit for a soil insecticide to safeguard their crop. Because the caterpillars cause damage in multiple forms, as stem-borers, feeding externally on crowns of the hop as well as feeding underground on roots, chemical control can be difficult even if an effective, registered systemic insecticide had been available. Low efficacy of chemical control was already reported by LIEBL (1971) and FRENCH & al. (1973). Control by contemporary contact insecticides may also be ineffective as the treatment window, when caterpillars can be targeted, is extremely short, being limited to the periods when young caterpillars hatch and migrate to their host plant, or when they leave the stem they have burrowed in and move to the roots of the hop plant. The timing of these phases in the lifecycle is almost impossible to predict.

The monitoring of adult moths with a light trap revealed that in the Hallertau *H. micacea* has only one generation per year with their flight period occurring any time from mid-July to early October. During this period female moths lay their eggs, which are the sole overwintering stage of *H. micacea*. The eggs can tolerate very low temperatures and even require a minimum of two months near freezing

temperatures to terminate their diapause and induce high rates of hatching (WEIHRAUCH & FISHER 2009). The eggs that have been laid during late summer and autumn will therefore only hatch in early spring of the following year. Considering the biology of *H. micacea*, the only reasonable control measure therefore is to limit infestation pressure by maintaining hop gardens free of poacean weeds, especially of *E. repens* and *E. crus-galli*, thereby impeding oviposition by female moths. Severe levels of damage are always associated with weed-infested hop gardens. In some cases another member of the Poaceae, in the form of undersown oat *Avena sativa* seemed to contribute to the onset of *H. micacea* infestations. Observations from all *H. micacea* outbreaks hitherto reported from Old World hop growing regions, the duration of economically significant infestations is limited to a period of two or three years, after which the pest vanishes again for many years. This clearly also applies to the recent peak infestations in the Hallertau, where the occurrence of adult moths declined to a normal and absolutely tolerable level since 2015 and no significant damage by larvae has been reported during spring and early summer of that and the three following years.

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