WEED BIOLOGICAL CONTROL
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Work carried out by CABI Europe - Switzerland
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NOTES FROM THE SECTION LEADER

It might be interesting for you to know that our institute, CABI E-CH, is celebrating its 50th anniversary in the Kanton of Jura (a Kanton is similar to a U.S. State or a Canadian Province, just much, much smaller), and our 60th anniversary in Switzerland. A little historical review: In 1948 the Executive Council of CABI decided to open a substation in Switzerland. They first moved to Feldmeilen near Zürich. Dr Louis Mesnil, a well known authority on parasitic Diptera, was appointed as first Director. In 1958, what was then known as the European Station of CIBC (Commonwealth Institute of biological Control), moved from Feldmeilen into a rented facility at Delémont. When the lease expired, a piece of land was purchased in 1960, and the Executive Council approved the plans for a new building, which was inaugurated in September 1963. The local authorities even specifically named the road leading to the institute “chemin des Grillons” (the cricket lane). In 1997, the building was enlarged by 50%. Right now we are actually looking into options to expand again, since the old building has reached its carrying capacity especially during the field season.

To celebrate these anniversaries, we prepared a series of panels explaining the work we conduct in each of our four sections with selected examples. The panels were presented at a market day in Delémont at the end of August (see pictures below), and will be displayed along the road to the institute this autumn.

In addition, we are celebrating 60 years of research collaboration between CABI and Canada. A workshop and Jubilee reception is being jointly organized by CABI and AAFC (Agriculture and Agri-Food Canada) during the Entomological Society of Canada meeting on 20 October 2008 in Ottawa.

By the way: you might have already wondered why the acronym of our new name CABI Europe-Switzerland is CABI E-CH. The CH stands for Confederatio Helvetica (from the latin name Helvetia for Switzerland).

I would also like to mention that we hosted several visitors this year: between 10 June and 20 August, we had Dr Ikhram Abdullaev (University of Urgench, Uzbekistan) as a visiting scientist. Dr Abdullaev is the Dean of the Faculty of Natural Sciences and will therefore be an important collaborator in the future. He gained insight into several of our weed biocontrol projects while receiving English lessons from our North American students. During June, we hosted Quinn Bloom, an MSc student from Montana State University, who is researching the potential of pathogens as biological control agents for hawkweed. We took the opportunity to organize a joint survey for insects and pathogens in Eastern Europe. In September our long-standing Romanian collaborator Dr Alecu Diaconu and his son came to visit combining work and a couple of days of holiday.

Finally I have the pleasure to let you know that our colleague Gitta Grosskopf not only got married and is now Gitta Grosskopf-Lachat, but also gave birth to a baby boy on 16 September. His name is Felix, which means “the happy one” and he does appear to be a very happy and content child. Gitta is planning to come back to work part time in January 2009.

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The CABI Team presenting information panels about our work at a Saturday market day in Delémont
TANSY RAGWORT (JACOBAEA VULGARIS)
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The flea beetle Longitarsus jacobaeae (Col., Chrysomelidae) is considered to be the main factor for the successful control of tansy ragwort in temperate regions of the western USA. However, the introduced strain, which was originally collected in Italy, has a summer diapause that makes it poorly adapted to cooler regions in North America. While the Swiss strain has already been introduced into the USA, further studies on its host-specificity have been requested by Canada.

Between 2005 and 2008, a series of no-choice and one multiple-choice test were carried out using 13 different representatives of the genus Senecio sensu lato. The results indicated that the host-range of the Swiss biotype is restricted to the newly named genus Jacobaea, a genus which is not represented in the native flora of North America. Other representatives of the genus Senecio sensu lato either supported larval development or were partly accepted for oviposition under no-choice conditions, but levels of oviposition were so low that it seems unlikely that L. jacobaeae will use them as field host plants.

To test this hypothesis, a second multiple-choice field experiment was established at CABI E-CH with 210 potted plants in 2007. Between June and August 2008, all test and control plants were individually covered with gauze bags and regularly inspected for emergence of L. jacobaeae adults. In late August, when adult emergence had ceased, the roots of plants from which adult L. jacobaeae were collected were inspected for larval feeding damage.

As predicted, the large majority of adults emerged from J. vulgaris, and a few from Jacobaea maritima. Adult emergence from other test plants was rare or absent. These results, which strongly support previous findings, have been incorporated into a draft petition for field release, which has been sent out for internal review.

DALMATIAN AND YELLOW TOADFLAX (LINARIA SPP.)
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2.1. Rhinusa pilosa (=R. hispida) ex L. vulgaris and R. brondelii ex L. genistifolia (Col., Curculionidae)

A total of 2,119 Rhinusa pilosa and 1,319 R. brondelii were obtained from mass rearing and gall induction tests carried out in 2008. All adults are kept in cages for aestivation and hibernation.

Single-choice gall induction tests with R. pilosa and R. brondelii were set up with L. vulgaris NA and L. dalmatica and 18 test plant species including 13 North American Scrophulariaceae. Gall induction by R. pilosa was recorded on Sairocarpus virga and S. nuttalianus but without larval development. Sairocarpus virga and S. nuttalianus were less suitable for gall induction by R. brondelii and only few galls were recorded on these plant species. Detailed results will be presented in the Annual Report.
2.2 MSc thesis

Emily Barnewall is pursuing her MSc thesis at the University of Lethbridge, Alberta in collaboration with CAB E-CH. Emily will mainly work on gall induction of *R. pilosa*. A rearing colony of *R. pilosa* has been established in quarantine. Of the 200 galls that were collected in Serbia this spring, 122 have been successfully embedded in paraffin wax and will be sectioned this winter to determine gall development over time.

2.3 *Mecinus heydeni* ex *L. vulgaris* and *M. laeviceps* ex *L. genistifolia* (Col., Curculionidae)

The mitochondrial COII gene sequence of the specimens collected in Harmanli (East Bulgaria), which is the type locality of *Mecinus bulgaricus* Angelov, 1971, showed 100% similarity with *M. laeviceps* from Eastern Serbia reared from *L. genistifolia*. This result supports our hypothesis that *Mecinus* specimens reared from *L. dalmatica* ssp. *macedonica* belong to a new species and can thus be regarded as a new potential biological control agent for Dalmatian toadflax.

Mass rearing attempts of *M. heydeni* (ex *L. vulgaris*) resulted in 539 adults, which are being kept in cages for aestivation and hibernation. Larval development of *M. heydeni* was similar on *L. vulgaris* of European and North American origin.

Single-choice tests with *M. laeviceps* reared from *L. genistifolia* showed that only *L. genistifolia*, *L. dalmatica* NA and *L. grandiflora* are suitable plant species for normal larval development. *Linaria vulgaris* was a less suitable host, and only few larvae developed. No larval development was recorded on *S. virga*, *S. nuttallianus*, *S. multiflorus* and ten *Penstemon* species tested.

3 HOUNDSTONGUE (*CYNOGLOSSUM OFFICINALE*)

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3.1 *Mogulones borraginis* (Col., Curculionidae)

Between 19 June and 16 July, over 2,000 larvae of the seed-feeding weevil *M. borraginis* emerged from 76 houndstongue plants set up for rearing. Up to 25 larvae were transferred into plastic cups (6.5cm diameter, 8.0cm high) filled with sifted soil for pupation. They are currently being kept in an underground shelter and will be checked for adult emergence in spring 2009.

4 HAWKWEEDS (*PILOSELLA SPP.*)

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4.1 *Aulacidea subterminalis* (Hym., Cynipidae)

At the end of August 2008, 45 *Pilosella officinarum* pots were checked for *A. subterminalis* galls and 454 gall clusters, containing an estimated number of 1,840 gall chambers were retrieved. The two field plots used for mass-rearing the wasp had 501 gall clusters containing an estimated number of 2,161 gall wasp larvae. All galls were transferred into plastic containers with humid vermiculite for overwintering. One
part of the galls will be used for maintaining the rearing colony at CABI E-CH, while the other part will be shipped to the quarantine facility in Bozeman, Montana, USA.

4.2  *Aulacidea hieracii* (Hym., Cynipidae)

In no-choice gall development tests, four out of eleven *Pilosella caespitosa* plants exposed to *Aulacidea hieracii* (ex *Pilosella procera*) developed galls. Oviposition into the bolting stem can completely inhibit seed production of the attacked stem (see plate, left photo). The only *P. procera* plant offered in no-choice tests had no galls. As in previous years, none of the *H. robustum* plants were galled by wasps reared from *P. procera*. In contrast, *A. hieracii* females reared from *Hieracium robustum* galls collected in Ukraine attacked exclusively their field host plant, *H. robustum*, in screening tests. These results clearly indicate the existence of host races or different species within *A. hieracii*

No galls were found on any of the plants offered in multiple-choice gall development tests carried out with *A. hieracii* ex *P. procera*. However, oviposition behaviour was observed on a bolting *P. caespitosa* plant.

4.3  *Cheilosia urbana* and *Cheilosia psilophthalma* (Dip., Syrphidae)

The impact experiment using different densities of *C. urbana* on the target weed *P. caespitosa*, and a non-target plant, i.e. *H. gronovii*, will be evaluated in the second half of September. All plants will be harvested and the number of rosettes, leaves, and flower heads recorded. The above-ground biomass of all plants will be harvested to determine their dry weight. No-choice larval transfer tests will be checked for immature stages of *C. urbana* in late September/early October 2008. Data will be analyzed and results presented in the Annual Report 2008.

No-choice larval transfer tests set up with *C. psilophthalma* were checked for immature stages between 10 and 12 September 2008. Larvae were exclusively retrieved from *P. caespitosa*.

4.4  Surveys for new potential biological control agents of hawkweeds

In early June, Dr Boris Korotyaev (Russian Academy of Sciences) visited several field sites of *Pilosella* spp. in Southern Russia as described in the June quarterly report. Herbarium specimens were taken at all sites and will be identified by a botanist. One of the sites was visited again on 11 July to collect 33 stem galls of *Pilosella* sp. most probably caused by the gall wasp *Aulacidea hieracii*. Some of the galled stems did not produce any or only a few flower heads (see photo). In addition, long, slender galls were collected at the same site but it is of yet unclear which species induced gall formation. Coleoptera larvae were found mining in the galls but it is unlikely that they are the gall inducer.

A field trip to Eastern Austria was carried out in early August in cooperation with Dr Georg Scheibelreiter (Austria) to check *P. officinarum* for stolon-mining insect larvae. Eight sites were visited. One hundred stolons were dissected immediately at two sites in the field. Samples from all eight sites were taken back to Delémont and about 1,854 stolons were dissected in the lab. Apart from the insect species already known from earlier surveys, no potential biological control agents were found on this trip.
Pilosella caespitosa stem galled by Aulacidea hieracii reared from Pilosella procera (left), galls of Pilosella sp. collected in Southern Russia in July 2008.

5 RUSSIAN KNAWEED (ACROPTILON REPENS)
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5.1 Field surveys in Iran
In 2008, the herbivores associated with Russian knapweed were surveyed in Iran in collaboration with Dr. R. Ghorbani and Mr. Asadi of Mashhad University, Iran. Three sites each in three different regions of Iran were surveyed throughout the growing season. The herbivore species collected will be sent to taxonomists for identification.

5.2 Aulacidea acroptilonica (Hym., Cynipidae)
First field cage releases of A. acroptilonica were made in Canada by R. Bourchier (AAFC, Lethbridge, Canada). The permit for field release of the gall wasp in the USA was issued in May 2008. However, attempts to obtain adult emergence from galls kept in cold storage until June failed. It is planned to start releases of the gall wasp in the USA in 2009. In August, some 1,000 galls were collected in Uzbekistan. These galls will be overwintered at CABI EU-CH and shipped to different quarantine facilities in North America in early 2009.

5.3 Jaapiella ivannikovi (Dip., Cecidomyiidae)
The petition for field release of J. ivannikovi, submitted to TAG in February 2007, is still under review. In 2008, an impact experiment was carried out in Uzbekistan assessing the individual and combined impact of the biological control candidates J. ivannikovi, the gall wasp Aulacidea acroptilonica (see above) and flower-head attacking tephritid flies Urophora spp. The goal of this study is to assess whether multiple attack by these biological control candidates increases herbivore impact on A. repens, or whether the herbivores interfere with each other, which may lead to reduced population growth of the biological control agents when released at the same site. In September 2008, the shoots of the experimental plants will be harvested and shoot height, above-ground biomass, number of seed-heads and number of seeds will be determined.
5.4 **Cochylimorpha nomadana** (Lep. Cochylidae)

To assess the impact of *Cochylimorpha nomadana* on Russian knapweed, we experimentally transferred five freshly hatched larvae onto individual shoots in August 2007. In summer 2008, each infested shoot was paired with a control shoot that was randomly selected within a distance of max. 2 m from the infested shoot. All shoots were harvested in mid August and taken back to the institute to determine shoot height, above-ground biomass as well as number of seed-heads and seeds.

5.5 Eriophyid mite from Iran

In 2006, an eriophyid mite species was found attacking *A. repens* in Northern Iran. A field experiment was set up to assess the host-specificity of the eriophyid mite under field conditions. The infestation rate at the site where the mite was originally found was very low, but our Iranian collaborators found additional sites with large populations of the mite. Russian knapweed shoots infested by the mite were transferred to the experimental garden and placed besides each of the control and the test plant species so that the infested shoots touched the leaves of the plants. In autumn 2008, all experimental plants will be harvested and carefully inspected for mite attack under the microscope.

6 **CANADA THISTLE (CIRSIUM ARVENSE)**

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6.1 Multitrophic interactions and the population dynamics of *Cirsium arvense* – a biogeographical perspective

Michael Cripps, PhD student at Lincoln University in New Zealand, continued his experiments at the field site established last year in St. Ursanne, Switzerland. At regular intervals, all *C. arvense* plants were measured and pesticides applied from shoot emergence until the peak flowering period. Unfortunately the fence protecting the study area from grazing animals was removed, and measurements had to be discontinued. To investigate the effect of high herbivore levels, an additional plot was established in each block, in which the biological control agent, *Cassida rubiginosa* was added. Twenty larvae (1st to 2nd instar) were added to each shoot. The number of larvae was counted on 4 and 20 June, and if necessary new larvae were added to keep the densities constant. Regular shoot measurements continued in these plots, as in the other treatments.

Work also continued on the experiment investigating the impact of *Cassida* larvae on *C. arvense* under different levels of plant competition. On 12 June, low (5 larvae) and high (20 larvae) *C. rubiginosa* densities were applied, and all pots were individually covered with gauze bags. The number of larvae was counted on 19 and 27 June, and if necessary new larvae were added to keep the densities constant. Clipping (simulated grazing) treatments were applied twice per week for the duration of the experiment. Measurements were taken on 12 June (pre-*Cassida* release), 26 June and 10 July. Between 31 July and 5 August, plants were harvested and their phenology, shoot base diameter, height, and above and below ground biomass were recorded. The level of herbivory was recorded for each shoot using a visual scale from 0 (no feeding) to 5 (heavy feeding). In addition a 4 gram sub-sample of lateral roots (ranging from 1.3 to 2.5mm diameter) was taken to assess the number of
adventitious shoot buds. The sub-sample of roots was clarified in a solution of 80% lactic acid to make the non-erupted buds visible, which were then counted using a binocular microscope.

Michael Cripps taking shoot measurements in St. Ursanne (left), and taking down the Cassida impact experiment (right).

7 GARLIC MUSTARD (ALLIARIA PETIOLATA)
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7.1 Ceutorhynchus alliariae and C. roberti (Col., Curculionidae)
No adults emerged from the native North American Schoenocrumbe linifolium exposed under no-choice conditions to C. alliariae (see last Quarterly Report), while 12 and six adults emerged from the simultaneously established garlic mustard plants.

To investigate whether the three test species that supported development under no-choice (Peltaria alliacea, Nasturtium officinale and Thlaspi arvense) would also be accepted under more natural conditions by C. alliariae and C. roberti, an open field test was established in April 2008 (for details see last Quarterly Report). All plants were harvested and dissected in May and eggs and larvae found were stored in 98% ethanol. Since immature stages cannot be distinguished morphologically between the two species, they were sent to Prof. Ruth Hufbauer and Dr. Steve Rauth (Colorado State University, USA), who kindly offered to conduct molecular analyses. Results available so far indicate that the garlic mustard plants (controls) were attacked by both species. Ceutorhynchus roberti attacked both Peltaria alliacea and Thlaspi arvense while so far only one larva of C. alliariae has been found in N. officinale. Detailed results will be presented in the Annual Report.

On 14 July, 55 C. alliariae and 350 C. scrobicollis reared at CABI E-CH were shipped to the quarantine facility in Minnesota, USA to augment the existing rearing colony.

7.2 Ceutorhynchus constrictus (Col., Curculionidae)
In the no-choice oviposition and larval development tests established, eggs were found on all garlic mustard control plants exposed. During dissections, we also found
eggs on *Cakile edentula* and *Descurainia pinnata var. nelsonii*, however, no larvae completed their development on these species. Between 16 and 30 June, an average of $12.3 \pm 1.5$ mature larvae emerged from garlic mustard. Larvae collected were transferred into vials filled with sifted soil for pupation and are currently being kept in an underground insectary for adult emergence next spring.

### 7.3 *Ceutorhynchus scrobicollis* (Col., Curculionidae)

A shipment of adult *C. scrobicollis* was made to the USA in July (see above). A small number of adults were kept at CABI E-CH to continue our rearing colony.

### 8 COMMON REED (*PHRAGMITES AUSTRALIS*)

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#### 8.1 Moth rearing

Rearing of the four noctuid moths *Archanara geminipuncta*, *A. dissoluta*, *A. neurica*, and *Arenostola phragmitidis* was always very labour intensive. For *A. geminipuncta* and *Arenostola phragmitidis*, we were able to reduce workload at the beginning of the rearing by transferring newly emerged larvae on potted plants. We see further potential to save time by simply transferring eggs onto potted plants covered with gauze bags. However, for *A. dissoluta* and *A. neurica*, and for rearing from 3rd instar onwards, we still need to rear each larva individually on stem sections. Therefore, a semi-artificial diet would be very helpful for facilitating mass rearing, although earlier attempts were not very successful. Especially for *A. dissoluta*, we consider successful mass rearing without artificial diet to be unrealistic. Attempts to reduce workload during oviposition by keeping up to three pairs in wooden cages worked fine for *A. neurica*. We obtained over 3,800 eggs of this species. Though, the same method resulted in lower egg production for *A. geminipuncta* (n=650) and *Arenostola phragmitidis* (n=430). We plan to ship at least half of these eggs to the quarantine facility in Rhode Island, USA this fall for further host-specificity tests in 2009.

#### 8.2 Comparison of growth of reed populations

In early 2008, we compared above-ground biomass, average stem diameter and stem numbers of nine populations each from native North American, introduced and European reed. Results confirmed earlier observations: the native North American *Phragmites* has thicker but fewer stems than European plants when grown in pots. Interestingly, introduced populations grew differently than European reed and also had thicker but fewer stems. We found no significant differences in above ground biomass.
9 WHITETOP OR HOARY CRESS (*LEPIDIUM DRABA*)
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9.1 *Ceutorhynchus cardariae* (Col., Curculionidae)
During June 2008, 537 *C. cardariae* adults emerged from *L. draba* plants used in host-specificity tests and for rearing. In addition, 225 adults were field collected in Romania by our collaborator Dr Alecu Diaconu (Biological Control Institute, Iasi, Romania). Usually 15 females and ten males were placed into a transparent plastic cylinder and provided with cut *L. draba* leaves. At the end of July, 635 adults were still alive, i.e. 83%. As last year, half of the weevils will be overwintered at ambient temperatures in a wooden shelter, and the other half in an incubator set at constant 3 °C ± 1 °C.

9.2 *Ceutorhynchus turbatus* (Col., Curculionidae)
From the plants infested in the no-choice and single-choice oviposition and larval development tests (see June Quarterly report), larvae (n=25) only emerged from *L. draba* control plants. No larvae emerged from *Draba nemorosa*, the only test plant species on which an egg was found.

9.4 *Psylliodes wrasei* (Col., Chrysomelidae)
Between May and June 2008, 622 adults emerged from host-specificity tests established in autumn 2007 and spring 2008. Beetles were either placed onto potted *L. draba* plants or in cylinders for aestivation. As in previous years, oviposition began in late August. Eggs are currently being collected and placed in petri dishes for additional tests next spring.

Beetles that emerged from the native North American *Barbarea orthoceras* and *Lepidium oblongum* during no-choice larval transfer tests were kept on the same plant species during summer (see June Quarterly). On 27 August 2008, an oogenesis experiment was established to see whether females would be able to produce eggs when only fed with test plant material. Beetles were sexed and male-female pairs were placed into separate transparent plastic cylinders and offered cut leaves inserted in a moist block of florist sponge. Fifteen cylinders were set up with beetles originating from *B. orthoceras*, and six cylinders with beetles originating from *L. draba*. No *L. oblongum* could be set up, because the plant is an annual and all plants were senesced by the end of August. Leaves are regularly being checked for feeding and the florist sponges for eggs. To date, no eggs have been found on *B. orthoceras*, while eggs were found in all but one of the control cylinders. Although feeding has occurred in all 15 cylinders with *B. orthoceras*, the feeding rate is much lower than on *L. draba*. Results suggest that *P. wrasei* is unable to sustain a population on non-target species. Once beetles have died, they will be dissected, their sex verified and checked for ovariole development.

Due to reduced levels of funding, the open-field test and additional multiple-choice cage test planned for autumn 2008 had to be postponed.
9.5 *Melanobaris* sp. near *semistriata* (Col., Curculionidae)

In no-choice tests conducted with 16 test plant species, larvae were found in eight species (*Barbarea orthoceras*, *Erysimum asperum*, *Lepidium densiflorum*, *L. lasiocarpum*, *L. oblongum*, *Reseda lutea*, *Schoenocrambe linifolia* and *Stanleya pinnata*) apart from the control, *L. draba*. Larval survival on test plants was much lower than on *L. draba* and in most cases none of the larvae were able to complete development. Under single-choice conditions, *L. draba* was always preferred. Detailed results will be presented in the Annual Report.

9.6 PhD study

At the beginning of August, Carole Rapo, who started her PhD at the University of Idaho last August, went back to Idaho to continue course work and chemical analyses of plant samples. A committee meeting is planned in November before the Wyoming consortia meetings.

10 BUCKTHORNS (*Rhamnus* spp.)

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10.1 *Philereme vetulata* (Lep., Geometridae)

No eggs of *Philereme vetulata* were found in the multiple-choice field cage oviposition test established with *Rhamnus cathartica, R. cathartica* spp *dahurica, R. alpina* and *R. alnifolia* this spring (see last Quarterly Report). Results indicate that oviposition does most likely not occur in confined conditions. Eggs were neither found on *R. cathartica* in the open-field oviposition test established in the vicinity of the Centre. Therefore oviposition tests including North America *Rhamnus* species will be difficult.

10.2. *Trichochermes walkeri* (Hom., Triozidae)

Between late July and mid August, 4,200 leaf galls of *Trichochermes walkeri* were collected at three sites located in Western Switzerland. Sixty-three females and 90 males emerged from this material. Adults are currently being used for single-choice field cage oviposition tests with *R. cathartica* and *R. alnifolia* of North American origin. No choice sequential oviposition tests are being conducted with *Rhamnus alaternus* and *Rhamnus prinoides*.

10.3 *Wachtiella krumbholzi* (Dipt., Cecidomyiidae)

Fruits of *R. cathartica* and *Frangula alnus* were collected in Austria and Switzerland at the end of June and during July 2008. No midge larvae were reared from the fruits of *F. alnus*. In contrast, midge larvae were reared from all *R. cathartica* sites. In total, about a thousand larvae emerged from the fruits of *R. cathartica* resulting in 850 pupal cocoons, which are currently being overwintered.
Larvae of *Wachiella krumholzi* feeding in the fruit and seeds of *Rhamnus cathartica*

11 **DYER’S WOAD (ISATIS TINCTORIA)**
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11.1 *Ceutorhynchus rusticus* (Col., Curculionidae)
All weevils that emerged from host-specificity tests this summer were either placed on potted dyer’s woad plants (n= 216 females and 184 males) or in cylinders (n= 160 females and 139 males) for aestivation. When checked in September, 68% of *C. rusticus* kept on potted plants and 79% kept in cylinders had survived.

Unfortunately all further work planned with *C. rusticus* for autumn 2008 had to be postponed due to limited funding.

11.2 *Ceutorhynchus peyerimhoffi* (Col., Curculionidae)
Between 30 June and 18 July, 108 larvae of the seed-feeding weevil *C. peyerimhoffi* emerged from four dyer’s woad plants, successfully infested with this new potential biological control agent. Larvae were individually transferred into vials filled with sifted soil for pupation. Vials are being kept in an underground insectary for adult emergence in 2009.

11.3 *Psylliodes isatidis* (Col., Chrysomelidae)
All beetles that emerged from host-specificity tests this summer were either placed on potted dyer’s woad plants (n=603) or in cylinders (n=471) for aestivation. As of early September, 68% of beetles placed onto potted plants, and 74% placed in cylinders have survived.

Unfortunately all further work planned with *P. isatidis* for autumn 2008 had to be postponed due to limited funding.

11.4 *Aulacobaris licens* (Col., Curculionidae)
No-choice oviposition and development tests were established with 19 plant species and varieties, with 1 to 3 replicates each (see June Quarterly). Plants were dissected at least 10 days after infestation and the number of larvae and/or mining recorded.
So far, valid replicates were obtained from 18 plant species and varieties, of which eight were attacked. Detailed data will be presented in the Annual Report.

12 PERENNIAL PEPPERWEED (*LEPIDIUM LATIFOLIUM*)
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This project is conducted together with Dr Massimo Cristofaro from BBCA based near Rome in Italy.

12.1 *Melanobaris* sp. near *semistriata* (Col., Curculionidae)
Oviposition of adults that were collected in April in Turkey (see Quarterly June 2008) continued until the beginning of July. During this period we conducted no-choice oviposition and development tests with 26 plant species and varieties with 1 to 7 replicates each. Plants were dissected at least four weeks after infestation to allow sufficient time for development. For all test plant species with attack, additional replicates were kept to test if larvae are able to complete development. Thirteen out of 15 PPW plants showed signs of mining and in eight, larvae were found. Nineteen of the 26 test species exposed showed signs of attack (mining, dead and/or living larvae) however, in none of the test plant species kept for adult development, pupae and/or adults were recorded. Detailed data will be presented in the Annual Report.

In addition, single-choice tests were established by simultaneously offering PPW and a test plant species. Of eleven plant species tested (N=2-4 replicates/species) seven were attacked to some degree, but PPW was clearly preferred over most of the species exposed. Detailed data will be presented in the Annual Report.

12.2 *Phyllotreta reitteri* (Col., Chrysomelidae)
From no-choice larval transfer tests established with 18 species and/or varieties this spring, adults emerged from four species: *Brassica nigra*, *Lepidium densiflorum*, *L. draba* and *L. oblongum*. Detailed data will be presented in the Annual Report. All beetles that emerged from PPW are being kept in cylinders provided with cut PPW leaves and on potted plants. Beetles will be overwintered in an incubator at 3 °C.

12.4 *Ceutorhynchus marginellus* (Col., Curculionidae)
All reared and field collected adults are currently being kept in cylinders and are provided with cut PPW leaves and shoots. Beetles will be overwintered in an incubator at 3 °C.

13 SWALLOW-WORTS (*VINCETOXICUM* SPP.)
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This project is conducted in cooperation with Prof Richard Cassagrande and PhD student Aaron Weed from the University of Rhode Island (URI), USA. Based on the great progress achieved in the last two years, work at CABI E-CH concentrated on the biology and host-specificity of three of the five prioritized potential biological control agents in 2008.
13.1 *Abrostola asclepiadis* (Lep., Noctuidae)
A shipment of 20 pupae of the defoliator *A. abrostola* (originating from Switzerland) was received from A. Weed on July 1. All adults hatched and laid over 700 eggs. The newly hatched larvae were used for the combined impact study with *Eumolpus asclepiadeus* (see below).

13.2 *Eumolpus asclepiadeus* (Col., Chrysomelidae)
Studies of the life cycle of the root feeding chrysomelid *E. asclepiadeus* on *Vincetoxicum hirundinaria, V. nigrum* and *V. rossicum* hosts were continued. Our results demonstrate that 13 to 40% of the larvae take two years to complete their development and that only 1 to 5% of the larvae develop to adulthood within one year. Survival to adulthood was highest on the two target weeds, *V. nigrum* and *V. rossicum.*

No-choice larval feeding tests were carried out with ten test species native to North America in the families Asclepiadaceae and Apocynaceae. Plants will be dissected in early summer 2009. More than 1,200 larvae of *E. asclepiadeus* have been transferred onto *V. hirundinaria, V. nigrum* and *V. rossicum* to maintain the rearing colony and further testing in 2010.

To assess the potential impact of below- and aboveground herbivory on swallow-wort growth and reproduction, single and multiple herbivore treatments were established in summer 2008 with *E. asclepiadeus* and *A. asclepiadis.* The experiment will be harvested in autumn. Detailed results will be presented in the Annual Report.

13.3 *Euphranta connexa* (Dipt., Tephritidae)
*Euphranta connexa* is a known seed predator of *V. hirundinaria* in Eurasia. No-choice tests with *E. connexa* confirmed successful oviposition and larval development on the target weeds, *V. nigrum* and *V. rossicum.* Adult preference for pod size, larval developmental time and pupal weight were assessed to compare weed species in respect to *E. connexa* development. Results will be presented in the Annual Report. Over 250 puparia are currently being overwintered for no-choice and multiple-choice tests in 2009.

14 COMMON TANSY (*TANACETUM VULGARE*)
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14.1 PhD thesis
Vera Wolf, a student of the University of Bielefeld, Germany, has started a PhD thesis at the beginning of 2008 in collaboration with CABI E-CH on the different chemotypes of *Tanacetum vulgare* and the implications for biological control. Work in Bielefeld is supervised by Professor Caroline Mülller. A common garden experiment was set up with populations of *Tanacetum vulgare* from 13 different European countries and nine states/provinces in North America. Stem height and diameter, number of stems and flower heads, and above- and belowground biomass were recorded after 3.5 months. The germination rate, dry matter content and trichome density of leaves were also determined. Leaf samples of different developmental stages were taken for terpene analysis and for DNA and C/N-ratio studies.
14.2 *Isophrictis striatella* (Lep., Gelechiidae)

Adults of *Isophrictis striatella* emerged in August and September from dry stems collected in 2007 and 2008. Nine plants, two North American populations of *Tanacetum vulgare* and a population of *Achillea alpina*, were used to test host specificity and overwintering of eggs and larvae on plants. Three males and three females *I. striatella* were transferred onto each plant. All plants will be dissected in spring 2009.

14.3 *Cassida stigmatic* and *C. denticollis* (Col., Chrysomelidae)

Newly hatched larvae of *Cassida stigmatic* or *C. denticollis* were either transferred into petri dishes and offered cut leaves or transferred onto potted plants comprising native North American and European species for host specificity tests. Forty plants were established and a total of 400 larvae were transferred (25 larvae/plant). Larval development to the pupal stage was recorded on the North American species *T. huronense*. No development was recorded on the European *T. parthenium* or on native North American species in the genera *Artemisia* and *Achillea*. Adults are currently being overwintered for multiple-choice tests in 2009.

14.4 Other potential biological control agents

Ninety-nine adults of the flea beetle *Longitarsus noricus* were collected in Russia on 15 July 2008. A total of 3,397 eggs were collected from these adults and larval hatch rates were determined. To determine the host range of *L. noricus*, 1,889 larvae were transferred onto 23 plant species, including native North American and European species. Larvae overwinter in the roots of plants. All plants will be dissected in spring 2009.

Adults of the shoot boring weevil *Microplontus millefollii* were placed onto nine individually potted, gauze-covered *T. vulgare* plants to study their oviposition and larval behaviour. All plants will be dissected in fall 2008.

One female and one male of the longhorned beetle *Phytoecia nigricornis* were placed onto individually potted, gauze-covered *T. vulgare* plants for oviposition. The plants with developing larvae are being kept over winter in a greenhouse to determine biology of this species and will be dissected in spring 2009.

15 RUSSIAN OLIVE (*ELAEAGNUS ANGUSTRIFOLIA*)

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Russian olive is a relatively new project that started in spring 2007 in collaboration with Dr Massimo Cristofaro from BBCA in Italy.
15.1 Field surveys
Surveys of the herbivore assemblages associated with Russian olive were carried out in Turkey, Uzbekistan (in collaboration with Prof. Khamraev, Uzbek Academy of Sciences, and Dr. Khaidarov, University of Samarkant), and in Iran (in collaboration with Dr. Ghorbani and Mr. Asadi, Mashhad University). A number of new herbivore species have been found, including a fruit-attacking moth, several weevil species and two cerambycid beetles. All herbivores will be sent to taxonomists for identification.

15.2 Aceria angustifoliae (Acari: Eriophyidea)
In June 2008, a field trip was made to Turkey to collect the newly described mite *Aceria angustifoliae* and to hand-carry it to CABI E-CH for further investigations on its biology and for establishing rearing cultures. Various attempts were made to inoculate Russian olive trees originating from Wyoming (collected by Lars Baker, Fremont County, Wyoming) under quarantine conditions. Two weeks after inoculation, low numbers of mites were detected on potted Russian olive trees, and by the end of September one tree showed conspicuous signs of mite attack. Further studies will focus on understanding the hibernation strategy of this mite, since attempts to collect the mite in late August failed, indicating that *A. angustifoliae* might leave Russian olive in autumn and overwinter elsewhere.

15.3 Ananarsia eleagnella (Lepidoptera, Gelechiidae)
This moth attacks and develops inside fruits of the wild and the cultivated forms of Russian olive. In western Uzbekistan, attack rate of fruits of the wild form of Russian olive by *A. eleagnella* is on average 45%. The larvae predominately feed on the soft parts of the fruit, but sometimes damage the hard seeds. Large collections of Russian olive fruits were made in Uzbekistan and transferred to the quarantine of CABI E-CH for studying the biology of the species and for conducting preliminary host-specificity tests.

15.4 Unknown geometrid moth from Turkey
Approximately 90 larvae of an unknown geometrid moth were collected in Turkey and hand-carried to CABI E-CH for preliminary host-specificity tests. Results indicate that the moth is not specific enough to be considered for release into North America. This species was therefore dropped from the list of potential biological control agents.

16 Oxeye Daisy (*Leucanthemum vulgare*)
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Oxeye daisy (*Leucanthemum vulgare*, Asteraceae; synonym *Chrysanthemum leucanthemum*) is a perennial herb with showy flower heads. According to the literature, oxeye daisy is considered to be a species complex or a highly variable species with varying ploidy levels. Oxeye daisy has been accidentally introduced into North America and New Zealand as a contaminant of seed, and as an ornamental. The two species that have been introduced into North America are often referred to as *Leucanthemum vulgare* and *Leucanthemum ircutianum*. The plants are naturalized throughout most of temperate North America where they occur in fields, pastures, waste places and roadsides. To date, oxeye daisy is a declared noxious...
weed in eight U.S. states (Washington, Montana, Wyoming, Colorado, Minnesota, Indiana, Kentucky and Ohio) and four Canadian provinces (British Columbia, Alberta, Manitoba and Quebec).

16.1 Field survey

In 2008, we started surveying sites with *Leucanthemum* species in the Swiss Jura (5), the French and German Rhine valley (5), the Alps (5), and the Pyrenees (11). The survey included the following species: *L. vulgare* (diploid), *L. gaudinii* (diploid), *L. halleri* (diploid), *L. ircutianum* (tetraptoid), *L. adustum* (hexaploid), *L. pallens* (hexaploid), *L. heterophyllum* (octoploid), *L. favargeri* (octoploid), and *L. maximum* (dodecaploid). Besides leaf-mining flies, we found at least five different Lepidoptera larvae (2 root feeders, 2 stem/flower miners, and one external feeder), one root-feeding weevil, and two stem-mining Dipteran larvae. In addition, we found root galls on *L. adustum* in the Alps and on *L. maximum* in the Pyrenees. However, galls were already empty when we collected them, so it remains to be shown which species caused them. Flowers were often damaged by tephritid flies. All herbivores found will be sent to taxonomists for identification. From each population we sampled herbarium material and dug up 2-3 plants that were transferred to flower pots in the institute’s garden.

We will revisit sites in late fall to search for larvae of herbivores overwintering in the roots and to collect seed material.

Root gall on *Leucanthemum adustum*, and Crazy daisy, a cultivar of Shasta daisy (*Leucanthemum x superbum*) growing in our common garden.

16.2 Test plant species

We compiled a draft version of the test plant list and started growing several test plant species, including varieties of Shasta daisy. Shasta daisy, which is widely planted as an ornamental in North America, is often referred to as *Leucanthemum*
maximum, an endemic species of the Pyrenees (Spain and France). However, Shasta daisies are morphologically distinct from L. maximum growing in the natural habitats in the Pyrenees. Most probably, Shasta daisies are hybrids between L. maximum and several other Leucanthemum species.

17  **SULPHUR CINQUEFOIL (POTENTILLA RECTA)**  
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**4.1 Diastrophus sp. near mayri from Turkey (Hym., Cynipidae) and Diastrophus mayri from Ukraine (Hym., Cynipidae)**

None of the plants offered in sequential no-choice or multiple-choice gall development tests in spring 2008 were galled. The reason for the unsuccessful attempt remains unclear since control plants in different phenological stages were exposed to the wasps and the temperature was favourable. During a collection trip in Ukraine for a potential biological control agent of invasive Pilosella spp., galls of Diastrophus mayri were collected in the mid September by our collaborator Dr Victor Fursov (Institute of Zoology of Ukrainian Academy of Sciences, Kiev) and will be sent to Delémont for overwintering and potential additional tests in 2009.

**4.2 Gall midge from Turkey (Dipt., Cecidomyiidae)**

Of the galls collected in early November 2007 in Western Turkey by our collaborator Dr Ferit Turanli (Ege University, Izmir) only four males and eleven females emerged between 7 and 10 May. Five adults used in screening tests were preserved in alcohol and sent for identification together with dried galls. On 8 August 2008, some of the dry galls were opened. Up to 25 white cocoons were found in each gall, but most of them contained dead pupae. Thus, a future collection trip of this species, which has more than one generation per year, should rather be made in early summer.

18  **JAPANESE KNOTWEED (FALLOPIA JAPONICA)**  
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Japanese knotweed is not only a highly invasive weed in North America, but also in Europe. In 2003, a biological control program was initiated for the UK with some additional funding from North American sponsors to include North American test plants. To date, the most promising biological control agents are the psyllid Aphalara itadori and a leaf spot fungus (Mycosphaerella). An application for release has been submitted to the UK authorities as the psyllid has shown remarkable specificity both in ovipositional preference and nymph development. Twenty species of native North American plants, supplied by our collaborators in the USA, have been screened to varying degrees, and results so far are promising.
Late nymph of *Aphalara itadori*

Leafspot symptoms in the lab

After the transfer of the cultures to our newly-built quarantine facility in Egham the psyllid population crashed and considerable efforts were expended in identifying the cause which turned out to be reduced humidity caused by increased airflow. Work has focused on acquiring and propagating the number of test plant species to be used in host-specificity tests with the psyllid and leafspot fungus. Thanks to field collection efforts in North America, seeds from 13 additional native species have already been received and testing has begun on these. In the past week a batch of seeds has been received from the USA and these will be put through an artificial winter prior to propagation later this year. Nymph transfer studies have confirmed the inability of the agent to successfully develop to adult on closely-related species.

The leafspot host range testing and life-cycle studies have continued in the laboratory with mixed results. Whilst the host range results are encouraging it has proven impossible to take the fungus through its complete life-cycle so a large-scale experiment has been established in Japan to determine the reproductive process under natural conditions.

A proposal has been prepared for consortium funding so that the current programme can be fully expanded to satisfy the needs of North America and fully exploit the considerable knowledge gained by the CABI team. Presentations will be made at the joint meeting of the Natural Areas Association Conference and the meeting of the Exotic Pest Plant Councils in Nashville in mid October and at a workshop entitled ‘Biology and Biological Control of Established Invasive Plants in Canada’ organized by Rob Bourchier (AAFC, Lethbridge, Canada) in Ottawa. It is hoped that more plant material can be hand carried back to the UK.
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