COST-SMARTER and risk assessment of *Ophraella communa*

H. Müller-Schärer, U. Schaffner, the COST-SMARTER Task Force Ophraella

Abstract - The North American leaf beetle *Ophraella communa* LeSage (Coleoptera: Chrysomelidae), a potential biological control agent of common ragweed, was recently and accidentally introduced to northern Italy and southern Switzerland. To assess the potential risks of non-target effects by this insect, we conducted in the frame of the EU COST Action SMARTER a series of host specificity studies, both under laboratory and open field conditions. Based on these results, *O. communa* appears to pose little risk to commercially grown sunflower and to native endangered plant species. Because it might generate high economic benefits by reducing health costs in the regions heavily invaded by common ragweed, we propose that European and national competent authorities should follow the example of France and conduct pest risk assessments that facilitate the decision process on how to respond to the arrival of this biological control agent of *A. artemisiifolia* in Europe.

Keywords: biological control, biosafety, host specificity, leaf beetle, accidental introduction

Ricevuto il Accettato il Pubblicato il

Background

The EU COST Action FA1203 on "Sustainable management of *Ambrosia artemisiifolia* in Europe" (SMARTER) was launched in February 2013 and will last for four years. Presently, close to 300 researchers from 33 countries (including USA, Canada, Australia and China) are registered participants of SMARTER, with specialists in weed research, invasive alien species management, ecology, aerobiology, allergology and economics. COST Actions interlink nationally funded research projects and enable and finance conferences, working groups, training schools and research exchanges. The focus of SMARTER is on developing novel and sustainable management options for Europe, such as biological control with insects and fungi (especially using alien species from the area of origin of *Ambrosia;* Gerber et al. 2011) and vegetation management (to achieve a competitive plant cover or tailored mowing regimes), as well as on forecasting atmospheric pollen concentrations for monitoring and for management evaluation. Furthermore, economic models are developed for impact assessment of ragweed and its management options. SMARTER will allow the various stakeholders to select optimal habitat- and region-specific combinations of control methods.

We briefly describe the response of SMARTER to the recent accidental introduction of a potential biological control agent to Europe, the North American leaf beetle *Ophraella communa* LeSage (Coleoptera: Chrysomelidae). After it was discovered in southern Switzerland and northern Italy in 2013 (Müller-Schärer et al. 2014), SMARTER immediately created a Task Force to assess potential risks and benefits of this herbivore. Here we summarize results of the various studies carried out so far to assess the potential risks of *O. communa* to non-target plants, including closely related crop plants (sunflower), ornamental plants (e.g. *Zinnia* spp.) and native European plant species.

Materials and Methods

During 2013-2016, we conducted extensive host specificity studies, both under controlled (in the quarantine facility at the University of Fribourg) and open field conditions (in Switzerland, Italy and China). Biosafety studies included egg and larval transfer tests in the quarantine and in the field, host choice experiments in the field, where *Ophraella* occurs now naturally, using a series of different experimental designs both in the presence and absence of *Ambrosia*. In total, we conducted some 80 experiments, testing all 6 *Ambrosia* species invasive in Europe (*A. artemisiifolia*, *A. trifida*, *A. psilostachya*, *A. tenuifolia*, *A. confertiflora* and *A. maritima*) and the closely related invasive *Parthenium hysterophorus*, 4 ornamental species (*Zinnia* spp.), 4 sunflower varieties (reflecting varieties used for oil production, as ornamentals and for green manure) and 10 native endangered species (NES) from European tribes closely related to the tribe Heliantheae, to which *Ambrosia* belongs. Field tests we carried out during 2015 and 2016 at 4 sites in Switzerland and Italy, exposing the test plants at each occasion during 3 time periods (cohorts in early May, mid-July and early September, each lasting 9 weeks) to mimic different levels of *Ophraella* densities and ratios of co-occurrence with the target species, including the late season conditions when availabilities of *A. artemisiifolia* are lowest and beetle densities highest. In addition, we performed extensive non-target field surveys on a total of 25 plant species in 55 localities (crops, other exotic species and NES) across Southern Switzerland and Northern Italy to monitor potential *O. communa* occurrence and damage of non-target species under natural conditions.

Results

From the locations in the Milano area where the beetle was initially found in 2013, the beetle expanded its range by 2016 to some 450km westwards to the border with Slovenia and Croatia, 200km eastwards to the

French border and each c. 150km north to near Bellinzona in Southern Switzerland, and south to near Ravenna in Italy.

Our biosafety studies conducted so far clearly show a strong preference of *Ophraella* for *Ambrosia* species, with *A. trifida* the least preferred. In no-choice tests in the quarantine, a few *O. communa* were able to fully develop on sunflower seedlings and impose considerable damage (above 80% leaf area removed). In our field experiments with sunflower, no eggs were laid at any site during the first and last cohort, and only a few ones during the second cohort (less than 3% of all eggs laid). A few larvae developed to pupae on sunflower during the second cohort, imposing only non-significant damage. In contrast, presence and damage by the adults on sunflower increased over the season at all sites, inflicting damage with yield reduction in cohort 3 (established in early September) especially at the site in Rovio, Ticino. During our extensive non-target surveys in 2014 and 2015, we found considerable damage by *O. communa* on *A. trifida*, *Xanthium strumarium* and occasionally significant damage on Jerusalem artichoke (*Helianthus tuberosus*), but only very limited damage by adults on sunflower leaves, with no impact on yield. No *Ophraella* were found on any of the 25 populations of 10 endangered or threatened plant species monitored during several occasions throughout 2016, even when *Ambrosia* and *Ophraella* populations were found within 2 km distance from the NES populations.

Discussion

Our host specificity tests and non-target surveys classify the very limited feeding of *Ophraella* on sunflower as a "spill-over" effect, meaning that field–grown sunflower is clearly not a suitable host plant for *Ophraella* and that the beetle would not be able to maintain persistent populations on sunflower. This confirms findings from earlier experiments made in China (Zhou et al. 2011) and from extensive field observation in the native range in North America, where *O. communa* has never been reported to occur on sunflower. However, adult feeding may well occur on sunflower later in the season (our third cohort). Importantly to note, however, is that sunflower for oil production is already harvested at the end of August, thus escaping the situation with high beetle densities in the absence of the target weed later in the season. More at risk will be sunflower grown as ornamentals and used as green manure that are still growing from September to December (the first frost), but these two uses of sunflower varieties are not in practice south of the Alps (in Ticino and Northern Italy), where the beetle presently occurs. We thus estimate this effect on sunflower yield as non-significant, but propose to quantify this in future studies. To better understand the likelihood of future evolutionary changes in host specificity, we initiated specific studies to assess the potential of *O. communa* to develop a sunflower strain using selection experiments, bioassays and genomic tools. Furthermore, indirect effects of high densities of *Ophraella* on the ecosystem via the food chain need to be monitored and carefully analyzed.

Conclusions

The SMARTER network offered an ideal framework to respond quickly to the recent establishment of *O. communa* in Europe. Results of the studies described above and on the impact of the biological control agent on common ragweed (Lommen et al., this issue) will be provided to national authorities to facilitate the decision process on how to respond to the arrival of this biological control agent of *A. artemisiifolia* in Europe. Capitalizing on the data collected in the Task Force *Ophraella*, France has put together a Pest Risk Assessment (Anses 2015) and in a follow-up action also an assessment of the potential benefits that might arise from a future establishment of *O. communa* on French territory. It was proposed that *O. communa* might generate high economic benefits by reducing health costs in the regions heavily invaded by common ragweed, but that some additional host-range testing should be done with rare and endangered species native to France before the beetle can be actively introduced or moved around within France (Chauvel et al., this issue). We propose that other countries, including Italy, Switzerland and Slovenia, should respond in a similar way to the establishment of *O. communa* in Europe. In Italy, the beetle has already colonized the majority of the area invaded by common ragweed. However, in order to achieve high impact on pollen release and seed production of this invasive plant also in years with relatively cool temperatures, Italy and other European countries might want to consider adopting China's approach which includes mass-rearing of the beetle and releasing it in large numbers in spring. In order to do this, competent authorities in Italy should follow France' initiative and conduct an assessment of the potential risks and benefits of further promoting *O. communa* densities in the areas invaded by common ragweed.

References

Anses (2015) Évaluation des risques pour la santé des végétaux liés à l'introduction accidentelle ou en tant qu'agent de lutte biologique, d'*Ophraella communa*, un insecte ravageur de l'ambroisie à feuilles d'armoise. Rapport d'expertise collective, 64 pp.

Gerber, E., U. Schaffner, A. Gassmann, H.L. Hinz, M. Seier, and H. Müller-Schärer (2011) Prospects for biological control of *Ambrosia artemisiifolia* in Europe: learning from the past. Weed Research 51: 559-573.

Müller-Schärer H., Lommen S.T.E., Rossinelli M., Bonini M., Boriani M., Bosio G., Schaffner U. (2014) *Ophraella communa*, the ragweed leaf beetle, has successfully landed in Europe: fortunate coincidence or threat? Weed Research 54:109-119.

Zhou Z.-S., Guo J.-Y., Zheng X.-W., Luo M., Chen H.-S., Wan F.-H. (2011) Reevaluation of biosecurity of *Ophraella communa* against sunflower (*Helianthus annuus*). Biocontrol Science and Technology 21, 10: 1147-1160.

AUTHORS

Heinz Müller-Schärer (heinz.mueller@unifr.ch), Department of Biology, University of Fribourg, CH-1700 Fribourg, Switzerland
Urs Schaffner (u.schaffner@cabi.org), CABI, CH-2800 Delémont, Switzerland
the COST-SMARTER Task Force Ophraella, http://ragweed.eu/task-forces/task-force-ophraella/

Corresponding author: Heinz Müller-Schärer