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IWGO NEWSLETTER

VOLUME XXVII **SEMI-ANNUALLY**
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EDITORIAL

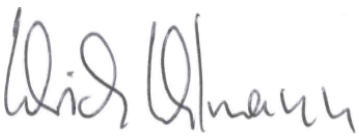
Dear Colleagues, Dear IWGO –Members

Here is the first issue of the IWGO Newsletter of 2006 (Number 1, Volume XXVII, March 2006). Many thanks for the good response regarding the IWGO Newsletter in December 2005, which was for the first time only available as a PDF file. Since the beginning of March 2006 you can now download the IWGO Newsletter from our newly designed webpage, www.iwgo.org, where you can also find other older issues of the IWGO Newsletter as a PDF file. As mentioned in the December 2005 issue, the IWGO Newsletter will be sent to a large number of active IWGO members as an e-mail attachment for your convenience. Please make sure that we have your correct e-mail address and also forward the new IWGO Newsletter to colleagues potentially interested in our IWGO activities.

I would like to remind you that you should please reserve the 5 to 8 November 2006 in your agenda as our next "big" 22nd IWGO Conference will be held in Vienna, Austria at this time. I am very grateful to a number of colleagues who have expressed a strong interest in organizing a scientific session. Please find in this IWGO Newsletter the confirmed scientific session topics and also the names of our colleagues, who are responsible for the specific sessions. If you have an oral presentation to offer please complete the electronic form for paper/poster submissions found on our webpage. At the same time, please also submit an MS Word-based, concise, 500-word abstract of your paper/poster written in English, as an e-mail attachment to the IWGO Conference Secretary (conference@iwgo.org). It is a requirement to follow the format outline for the preparation of the abstract. This is displayed on our webpage but also here in this IWGO Newsletter. Please refer to the scientific session subjects to ensure consideration. Deadline for submission of abstracts will be Friday, 28 April 2006. All abstract submitters will be notified as to the outcome of the selection process by Monday, 15 May 2006.

In this IWGO Newsletter please find news related to IWGO matters and some more contributions from our IWGO members Prof. C. Richard Edwards, Prof. Jozsef Kiss, Mr Nick Miller, Prof Stefan Vidal, and Dr. Stefan Toepfer. These IWGO Newsletter contributions are very much appreciated and I am looking forward to receiving more contributions in the near future. In addition, I have added abstracts from some recent WCR papers published prior to November 2005, which I have obtained from the Plant Protection Database of CABI Publishing, Wallingford, UK.

With kind regards,



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News Related to IWGO Matters

- **New Internet Platform for IWGO**
  Finally our new webpage has been established and you are most welcome to check it out. There is still room for improvements and the IWGO convenors are looking forward to hear constructive comments and what kind of information should be available. At this point the webpage presents general information about IWGO, conferences and Diabrotica meetings held in the past, IWGO Newslertters (downloadable as PDFs), Diabrotica spread map Europe and some useful links. In addition you will find information relevant for our next IWGO Conference, please klick on News 22nd IWGO Conference, 5 – 8 November 2006.

- **IWGO Proceedings in a Special Issue of the Journal of Applied Entomology**
  In the past, IWGO published its own proceedings in which oral and poster presentations were included. However this time we will have the opportunity to publish selected manuscripts from papers presented at the 22nd IWGO Conference in a special issue of the Journal of Applied Entomology. This special issue will complement our regular IWGO Newsletter, where abstracts will still be published for those papers not selected for inclusion in the journal. The language of the journal is English and all manuscripts will be evaluated in a peer-review process. This special issue will have up to about 20 papers that will be selected after the peer-review has been completed. Within the last year, the journal editors have been able to substantially reduce the time between manuscript submission and final publication (approximately 6 months). We would like for you to note that the submission of manuscripts, based on research results presented at the conference, to the Journal of Applied Entomology is optional and not obligatory for speakers. Needless to say, we are excited about this opportunity to partner with the Journal of Applied Entomology and to provide an avenue for publishing selected session papers.

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The 22nd IWGO Conference will take place in:

Vienna, Austria

November 5 to 8, 2006

Please reserve these dates!

History and Mission of this Conference

This conference is the continuation of a series of international meetings on *Ostrinia* and other maize pests that began in 1968. IWGO is a well-established large international working group, which deals today with all matters of maize pests and pest resistance. Focus areas of the 21st IWGO Conference in Venice, Italy, included many aspects of the ecology and management of *Diabrotica*, *Ostrinia*, *Agriotes*, *Sesamia*, aphids, etc. The intent of these IWGO conferences is to create a meeting for practitioners, a forum for information exchange, an event to build cohesion among the research community and to foster discussions of issues affecting the control of maize insect pests, particularly pertaining to the use of integrated control measures in the maize crop agro-system.

The 22nd IWGO Conference will be organized following this concept and will deal with all maize insect pests, not only *Diabrotica*. The scientific committee consists of Dr. Ulli Kuhlmann, CABI Bioscience Centre, Delémont (Switzerland); Prof. C. Richard Edwards, Purdue University, W. Lafayette, Indiana (U.S.A.) and Dr. Wang Zhen-Ying, Plant Protection Institute of CAAS, Beijing (P.R. China). The local organizer is Harald Berger (Vienna, Austria). After an international mailing requesting ideas for scientific sessions, session subjects and session organizers have been selected by the scientific committee. Afterwards speaker selection will be the responsibility of session organizers in collaboration with the scientific committee. Attendees who are not speakers have the opportunity to submit their research in the form of a poster presentation. All talks and posters will present original data from specific projects pertaining to maize pests. Efforts should be made to be specific and to avoid presenting overviews, summaries or material that is already widely known. The goal of the meeting is to stimulate ideas and discussion by presenting new information.

International Participation

An important goal of this meeting is to make it truly international, with good participation from all parts of the world. To promote this outcome, the job of the IWGO convenors will be to promote awareness of the meeting among IOBC, IWGO and non-IOBC members in specific geographic areas. Selected scientific session organizers should follow this concept to ensure an international atmosphere during sessions.

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Scientific Session Subjects

Scientific Session 1: Maize Insect Management with Genetically-Engineered Maize: Lessons Learned
Session Organizers: Leslie LEWIS, USDA-ARS, Ames, Iowa, U.S.A. and Rick HELLMICH, Iowa State University, Ames, Iowa, U.S.A.

Scientific Session 2: Compatibility of Insect-Resistant Transgenic Maize Plants with Biological Control
Session Organizers: Joerg ROMEIS, Agroscope, Zurich, Switzerland and Galan DIVELY, University of Maryland, College Park, MD, U.S.A.

Scientific Session 3 (Posters only): State of the Art of All Things *Diabrotica*: Biology, Population Dynamics, Genetics, Monitoring, Thresholds, Refuge Management, and Current Control Practices
Session Organizers: C. Richard EDWARDS, Department of Entomology, Purdue University, W. Lafayette, Indiana, U.S.A. and Ulrich KUHLMANN, CABI Bioscience Switzerland Centre, Delémont, Switzerland

Scientific Session 4: Classical Plant Breeding for Insect Resistance in Maize
Session Organizers: Bruce HIBBARD, USDA-ARS, Columbia, MO, U.S.A. and Marija IVEZIC, University of J.J. Stossmayer, Osijek, Croatia

Scientific Session 5: Trophic and Ecological Interactions with Maize Insect Pests
Session Organizers: Stefan VIDAL, University of Goettingen, Germany and Ted TURLINGS, University of Neuchatel, Switzerland

Scientific Session 6: New Biological Control Products to Control Maize Insect Pests: A Dream?
Session Organizers: Ralf-Udo EHLERS, e-nema, Raisdorf, Germany and ZHENG Li, Hengshui Tianyi Bio-Control Company, Ltd.,Hengshui, Hebei, P.R. China

Scientific Session 7 (Posters only): Free Themes
Session Organizers: Stefan TOEPFER, CABI Bioscience c/o Plant Health Service, Hodmezovasarhely, Hungary and Iona GROZEA, Banat's University of Agricultural Sciences, Timisora, Romania

Scientific Session 8: Implementing Maize IPM using Agro-chemicals: New Products and Trends
Session Organizers: Ibolya HATALANE ZSELLER, Plant Health Service, Hodmezovasarhely, Hungary and Mario BERTOSSA, Agroscope RAC Changins, Switzerland

Scientific Session 9: The Role of Genetics in Fighting the Western Corn Rootworm
SESSION ORGANIZERS: TOM SAPPINGTON, USDA-ARS, Ames, Iowa, U.S.A. and Thomas GUILLEMAUD, Institut National de la Recherche Agronomique (INRA), Sophia Antipolis, France

Scientific Session 10: *Trichogramma* Releases to Control *Ostrina* World-wide: Old Fashion or Still Trendy?
Session Organizers: WANG Zhen-Ying, Plant Protection Institute, Beijing, P.R. China and Dirk BABENDREIER, Agroscope Reckenholz, Zurich, Switzerland

Call for Papers and Posters

Starting immediately submissions for oral presentations and for posters are called for. Please refer to the scientific session topics, which have been sent as an e-mail attachment or are displayed on our IWGO internet site:

www.iwgo.org/conference/Vienna_2006/

Complete the electronic form for paper/poster submissions found at our internet site. At the same time, submit electronically an MS Word-based, concise, 500-word abstract of your paper/poster clearly written in English as an e-mail attachment to the IWGO Conference Secretary (conference@iwgo.org). It is a requirement to follow the format outline for the preparation of the abstract (please see below).

These abstracts will be forwarded to Session Leaders/Organizers for consideration and the best 5 will be selected for an oral presentation for the appropriate session. Invited speakers must present their talks in clearly spoken English and all talks must be of high scientific quality and interest. Unsuccessful submissions for oral presentations will automatically qualify for poster sessions. Deadline for submission of abstracts will be **Friday, 28 April 2006.** All abstract submitters will be notified as to the outcome of the selection process by **Monday, 15 May 2006.**

Those who are selected to give talks will be ask to submit an article for inclusion in the IWGO Proceedings (the date these articles will be due has not been set at this time, but for sure will need to be submitted by the time of the conference). We are in the process of negotiating with an international journal to see if a special issue containing these articles is possible. The format for these articles will be provided to speakers in due time.

Preparation of Abstracts – 500 Word Limit!
Submit to conference@iwgo.org

Presentation Type: (indicate whether this is an “oral” or “poster” presentation)
Session Number: (select the appropriate session number for the abstract)
Title: Bold, centered, Arial font size 14
Author’s Names: Not bold, centered, Arial font size 12. Author’s last names to be capitalized
Institutional Affiliations: Italics, left hand justified, Arial font size 10 (include author’s e-mail address)
Text of Abstract: Arial size 12 font, left hand justified. Level one heading left hand justified and underlined with period. Level two subheadings, 1.0 cm indentation and underlined with period. Level three subheadings, 1.5cm indentation, underlined, italicized with period. All species names must be italicized with author and order and family affiliations given at first mention. Tables, figures, and photographs can be included in the abstract and should be embedded where appropriate. Figure and table captions should be centered. Abstract text limit is 500 words! No more than 2 Tables or 2 Figures or 2 Photographs or combinations of two of these, such as 1 Table and 1 Figure, will be accepted. The final product should not exceed one page in A4 or letter format.

IWGO Confrence Proceedings

It is a pleasure to inform you that speakers at the 22nd IWGO Conference in Vienna, Austria, 5-8 November 2006, are most welcome to submit manuscripts with the aim to publish these in an international journal. In the past, IWGO published its own proceedings in which oral and poster presentations were included. However this time we will have the opportunity to publish selected manuscripts from papers presented at the conference in a special issue of the Journal of Applied Entomology. This journal publishes original articles on current research in all fields of entomology. This special issue will complement our regular IWGO Newsletter, where abstracts will still be published for those papers not selected for inclusion in the journal.

The language of the journal is English and all manuscripts will be evaluated in a peer-review process. This special issue will have up to about 20 papers that will be selected after the peer-review has been completed. The journal offers an online submission system for authors and reviewers. Within the last year, the journal editors have been able to substantially reduce the time between manuscript submission and final publication (approximately 6 months). We would like for you to note that the submission of manuscripts, based on research results presented at the conference, to the Journal of Applied Entomology is optional and not obligatory for speakers. However, this is an excellent way to get up-to-date research published in a timely manner. Session organizers of the 22nd IWGO Conference will be asked to help review the papers from their session.

Needless to say, we are excited about this opportunity to partner with the Journal of Applied Entomology and to provide an avenue for publishing selected session papers.

Meeting Location – Vienna, Austria

Vienna is the Capital of Austria and situated on the River Danube, at the foothills of the Alps and at the beginning of the Hungarian Lowlands. Average temperature in winter (Nov. - March) is 2°C, with short periods of rain or snow, minimum temperature -5°, aggravated somewhat by the constantly blowing Viennese wind. From the 13th century the Habsburg's ruled Austria. Vienna became the glamorous residence of a European empire, a melting pot of Slavic, Romance and Germanic tribes. Vienna became the centre of architecture, which includes the Old City with St. Stephan's Cathedral, the Hofburg, the City Hall and magnificent baroque houses. Public transport is excellent throughout the city. All points can be reached easily by underground, tram or bus.

Hotel

The conference hotel is the Parkhotel Schönbrunn. Parkhotel Schönbrunn was built in 1907 as the guest house of Emperor Franz Josef I and today offers modern comfort to those visiting Vienna. The imperial atmosphere of bygone days together with modern facilities and friendly service make the hotel unique. The indoor swimming pool with sauna offers entertainment and relaxation. All public rooms and most of the guest rooms were refurbished between 1999 and 2001. The hotel is located in the immediate vicinity of the "Schönbrunn Palace" and is surrounded by a park. The entrance to the park, with its various entertainment possibilities and the zoo of Schönbrunn, is directly opposite the hotel. The city center can be reached by underground U4 in about 8 minutes, the station 'Hietzing' is across the street from the hotel. We were able to negotiate very competitive rates for conference participants and we thoroughly recommend this hotel.

Cost

The conference costs for participants are as follows: hotel accommodations Euro 68 single room/night or Euro 83 double room/night including breakfast and taxes; early registration fee is Euro 220 and available until 31 May 2006 afterwards the registration fee will increase over time to a maximum of Euro 280. Registration fee includes the IWGO Conference Booklet, all coffee/tea breaks and lunches. It should be noted that through the support of national and international sponsors the welcome reception including food and beverages, the reception at Vienna town hall including food and beverages and the reception of the Ministry of Agriculture including food and beverages are free of charge to all registered participants. Individual financial support for conference participation is not available due to the lack of sponsorship for supporting the travel to international conferences such as the IWGO Conference.

IWGO Conference Secretary

We are looking forward to organizing a stimulating conference and hope that you will participate. If you have questions, please do not hesitate to contact the IWGO Conference Secretary in Switzerland (conference@iwgo.org). Also, please forward our website address to colleagues who may have an interest in the participating in the 22nd IWGO Conference.

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22nd IWGO Conference - Overview

Parkhotel Schönbrunn, Vienna, Austria
5 to 8 November 2006

Date	Activity	Location
SUNDAY, 5 NOVEMBER		
• 16:00	• Welcome Coffee and Tea	• Parkhotel –Sissi Bar/Empore
• 16:00	• Registration and Drop off Point Posters and Provision of PowerPoint Presentations	• Parkhotel –Sissi Bar/Empore
	• Installation of Posters	
• 17:00	• Welcome Buffet	• Parkhotel - Kaisersalon
• 18:30		• Parkhotel
MONDAY, 6 NOVEMBER		
• 07:30	• Late Registration	• Parkhotel – Foyer Elisabeth
• 08:00	• Welcome Address	• Parkhotel – F.-J. Saal
• 08:15	• Scientific Session 1	• Parkhotel – F.-J. Saal
• 10:00	• Coffee/Tea Break	• Parkhotel – Elisabeth Salon
• 10:30	• Scientific Session 2	• Parkhotel - F.-J. Saal
• 12:15	• Light Lunch Buffet	• Parkhotel - Wintergarten
• 13:30	• Scientific Session 3 (Posters)	• Parkhotel - Kaisersalon
• 15:15	• Coffee/Tea Break	• Parkhotel - Kaisersalon
• 15:45	• Scientific Session 4	• Parkhotel – F.-J. Saal
• 17:30	• End of Sessions	•
• 18:30	• Reception at the Town Hall	• Town Hall Vienna
TUESDAY, 7 NOVEMBER		
• 08:15	• Scientific Session 5	• Parkhotel – F.-J. Saal
• 10:00	• Coffee/Tea Break	• Parkhotel – Elisabeth Salon
• 10:30	• Scientific Session 6	• Parkhotel - F.-J. Saal
• 12:15	• Light Lunch Buffet	• Parkhotel – Wintergarten
• 13:30	• Scientific Session 7 (Posters)	• Parkhotel – Kaisersalon
• 15:15	• Coffee/Tea Break	• Parkhotel - Kaisersalon
• 15:45	• Scientific Session 8	• Parkhotel – F.-J. Saal
• 17:30	• End of Sessions	
• 18:30	• Reception Ministry of Agriculture	• Palmenhaus – Schönbrunn
WEDNESDAY, 8 NOVEMBER		
• 08:15	• Scientific Session 9	• Parkhotel – F.-J. Saal
• 10:00	• Coffee/Tea Break	• Parkhotel – Elisabeth Salon
• 10:30	• Scientific Session 10	• Parkhotel – F.-J. Saal
• 12:15	• Light Lunch Buffet	• Parkhotel – Wintergarten
• 13:30	• End of Meeting & Departure	
	• Dinner Suggestion “Heuriger Wine Restaurant”	• To be decided

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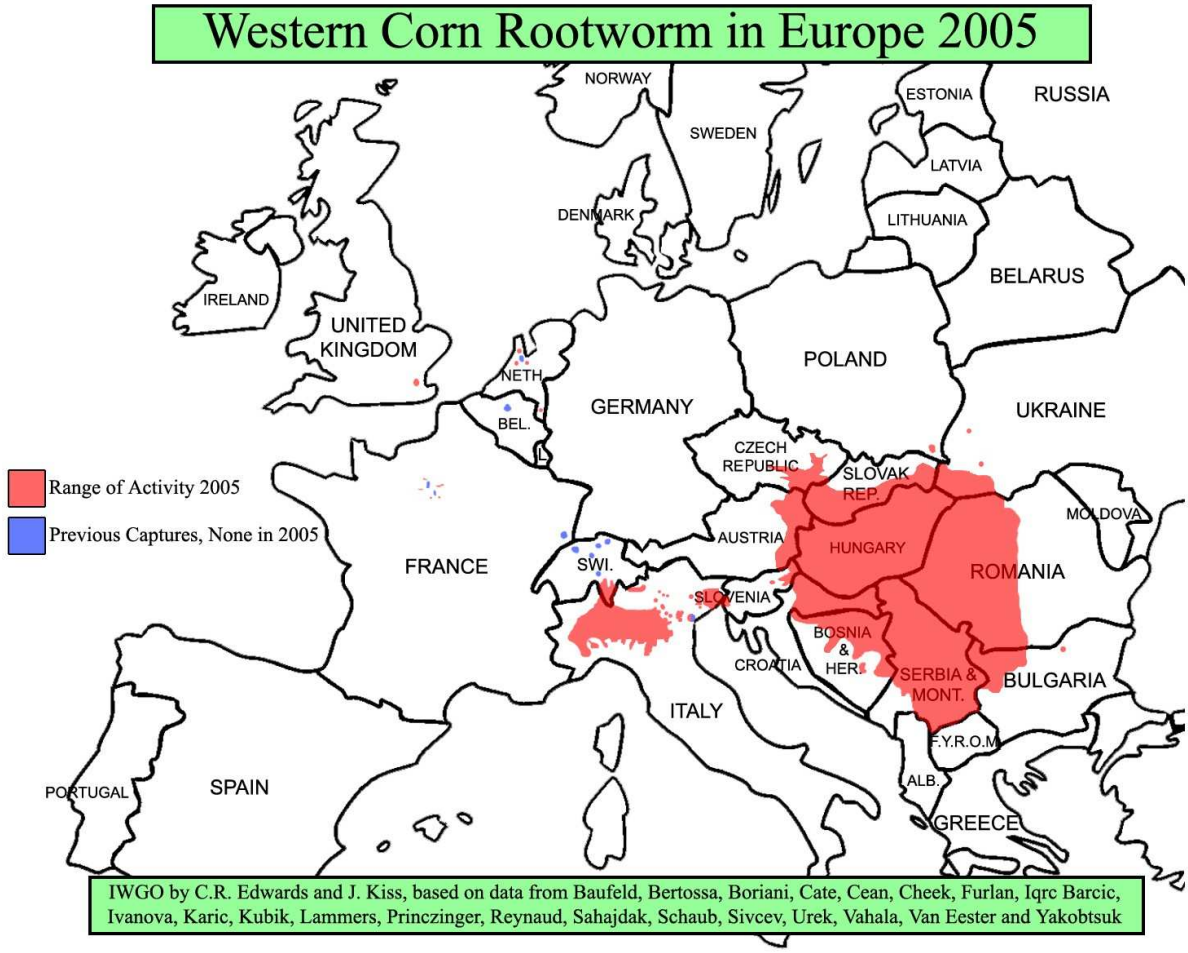
ARTICLE:

New WCR 2005 General Spread Map for Europe

by C. Richard Edwards[1] and Jozsef Kiss[2]
[1]*Department of Entomology, Purdue University, W. Lafayette, Indiana 47907, USA*
[2]*Department of Plant Protection, Szent Istavan University, Gödöllö, Hungary*

Here is the new WCR 2005 general spread map for Europe. Printable and downloadable maps showing the spread of WCR in Europe and North America as of 2004 can be found at http://www.entm.purdue.edu/wcr. These are general spread maps within tolerance of the precision level for maps such as these. We appreciate all those listed on the maps for their input. For the foreseeable future, IWGO plans to continue to produce these maps on a yearly basis with the help of those who are monitoring the movement of WCR within infested countries. We appreciate your assistance. We think these maps compliment the FAO map. Each serves a good purpose. You are on our mailing list to receive future updates, but you can also visit the www site listed above for this and future maps.



ARTICLE:

Diabrotica virgifera virgifera has crossed the Atlantic at least 3 times

by Nick Miller
Institut National de la Recherche Agronomique (INRA), Sophia Antipolis, France

Diabrotica virgifera virgifera was observed in Europe for the first time near Belgrade in 1992. Since then it has become established throughout a large part of Central and southeast Europe (CSE Europe). In addition, numerous disconnected outbreaks have occurred throughout Western Europe. Given this pattern, it easy to assume that the outbreaks in Western Europe were founded by insects originating from the established populations to the east. A recent study, lead by researchers at the French Institut National de la Recherche Agronomique, with participation by scientists from Europe and the United States has shown that this is not the case.

The study examined genetic variation at microsatellite markers within and between populations sampled from the United Sates Corn Belt, CSE Europe and five Western European outbreaks, three in France (Roissy, Val d'Oise and Alsace) and two in Italy (Ollegio and Udine). Because microsatellite markers are selectively neutral, the observed variation was due the populations' demographic and introduction history. Computer simulations were used to find the expected pattern of variation for different possible introduction scenarios. An "Approximate Bayesian Computation" method was then used to evaluate the statistical support for different introduction scenarios for each Western European outbreak.

The only Western European outbreak found to have originated from CSE Europe was Udine, Italy. In contrast, the Ollegio, Italy and Roissy, France outbreaks were shown to have originated from two additional, independent introductions from North America. The Alsace outbreak originated from the Roissy outbreak. The only outbreak whose origin could not be resolved was Val d'Oise which may have been founded either from Roissy or from North America. Thus there have been at least three independent introductions of *D. v. virgifera* from North America into Europe.

Reference: Nicholas Miller, Arnaud Estoup, Stefan Toepfer, Denis Bourguet, Laurent Lapchin, Sylvie Derridj, Kyung Seok Kim, Philippe Reynaud, Lorenzo Furlan and Thomas Guillemaud "Multiple Transatlantic Introductions of the Western Corn Rootworm" *Science* **310**: 992

ARTICLE:

Harmonise the strategies for fighting *Diabrotica virgifera virgifera* in Europe: A European Commission Specific Support Action

by Stefan Vidal
Institute of Plant Pathology and Plant Protection, University of Goettingen, Germany

Since the DIABROTICA project (QLRT-1999-01110: *Threat to European maize production by the invasive quarantine pest, Western Corn Rootworm [Diabrotica virgifera virgifera]: a new sustainable crop management approach*; results partly published in (Vidal et al. 2005) within the 5th EU framework program and contrary to the comment of the reviewer panel for the DIABROTICA project, assuming the problem of Western Corn Rootworm (WCR) invasion to Central Europe and subsequent yield losses would cease to be a problem on its own volition, WCR not only continuously spread to many countries adjacent to southeast Europe but also has been detected recently in isolated locations in Western European countries. Ongoing and repeated transatlantic invasions (Miller et al. 2005) on the one hand question the usefulness of emergency measures adopted by most member states of the EU on the basis of the directive 2003/766/EC to prevent further spread, and on the other hand require coordinated and integrated control programs to reduce damage to maize, especially in high intensity maize production areas throughout Europe. Although many research activities have been initialised aiming at implementing a diverse array of control options, information on the ecology of WCR in Europe is still scattered and integrated management options with regard to WCR are not yet fully harmonised within the EU.

To avoid parallel funding of research into the biology and to integrate control approaches of WCR a consortium of 13 partners with special expertise on specific aspects of the WCR problem in Europe has submitted a proposal within the 6th EU Framework Program (Call FP6.2004-SSP-4), entitled “Harmonise the strategies for fighting Diabrotica virgifera**”** aimed at coordinating and implementing an European action and research plan by harmonising and improving control options and by identifying priority research areas. This specific support action (SSA) proposal was positively evaluated by March 2005 and negotiations will hopefully be finalised within the next month to start the project, running for two years. The members of the consortium will either coordinate the project technically (**ARVALIS-Institut du vegetal, France**) or scientifically (**Georg-August-Universität Göttingen, Germany**) or will organise specific workpackages, subdivided in specific tasks, aimed at bringing together experts from all over Europe to share their knowledge and to address specific shortcomings and necessary activities to be adopted by the European Research Area. **Partner INRA- Sophia Antipolis (France)** will specifically address topics related to the ecology of WCR and will identify those areas where research is urgently needed on particular aspects within the next years. **CAB International (Switzerland)**, will establish a European core group of experts and institutions focusing on biological control options of WCR using macro- and microorganisms. Aspects of the chemical control options of WCR will be covered by the **Praktijkonderzoek Plant & Omgeving B.V. (The Netherlands)**; experts in this task

will discuss recent developments and future activities in chemical control of WCR, whereas the **Poljoprivredni fakultet u Osijeku (Croatia)** will concentrate on resistance and tolerance breeding programs in European maize cultivars to elaborate a collaborative European plant breeding program aimed at identifying sources of reducing WCR populations by breeding measures. Cultural control options will be discussed and evaluated by the task coordinated by the **Csongrád megyei Növény- és Talajvédelmi Szolgálat (Hungary)**, while **Szent Istvan Egyetem (Hungary)** will establish a European WCR IPM group comprising individual experts, institutes and main stakeholders to discuss national regulations and management practices to prepare risk management guidelines and a farmer training manual. The **Università degli Studi di Padova (Italy)** will evaluate monitoring programs with regard to economic threshold levels and will recommend trap types to propose a common standard for WCR data collection in Europe. The **Wageningen University (The Netherlands)** will perform cost-benefit and environmental analyses on several key strategic management options to evaluate the economic impact of WCR establishment for farmers and for the whole food supply chain. They will also conduct a market analysis for the potential use of biological control products in high value maize systems in Europe and will compare the practical compatibility and economic competitiveness of biological versus chemical control options. The **Federal Biological Research Centre for Agriculture and Forestry (Germany)** will assess the risk of future introduction of WCR to areas not yet colonized and will simulate the risk of establishment in these areas. Furthermore, this consortium partner will define measures aimed at WCR eradication and will recommend harmonised control strategies together with suppression measures elaborated by other tasks. The partner **Association Générale des Producteurs de Maïs (France)** will communicate the results and the information elaborated by the specific tasks and will maintain a webpage to provide farmers, stakeholders and research groups with the relevant information. The consortium partners responsible for the specific tasks will organise one to two workshops during the project period aimed at bringing together experts and stakeholders throughout Europe, already involved or interested in WCR ecology and management to discuss these issues. Their contributions and discussions will allow the ARVALIS-Institute du Vegetal and Georg-August-University Goettingen to draft an action and research plan, respectively, by the end of the project period. The former plan aims at setting up a framework for sustainable agricultural options with regard to WCR management, especially taking into account the specific demands of countries already harbouring WCR populations in contrast to those countries which still would benefit from containment and eradication measures. The latter will rank the identified gaps in WCR ecology and agronomic research issues with regard to WCR control.

The research and action plan will be discussed at an international symposium, organised by Georg-August-University Goettingen, to bring together research groups, experts, stakeholders, plant protection services and companies, inter alia, involved in various aspects of WCR ecology and management, to finally discuss the conclusions of the project in detail. Recommendations will be forwarded to enable the EU commission to fund research issues with highest priority.

The project scientific and technical coordinator will chair a project strategic committee (PSC) throughout the project period, which will be composed of the workpackage leaders, the task leaders, and associate stakeholders, and external experts, respectively, to foster the potential exploitation and implementation of the results elaborated by the specific tasks and to enable decision making processes during the project. All activities included in the EU specific support action should raise public participation and awareness of the WCR problem in Europe and should help to implement coordinated control measures in order to meet the long term objective of the EU for sustainable and environmentally adapted agricultural production systems, even under the pressure of a highly damaging pest species.

References:

Miller N., Estoup A., Toepfer S., Bourguet D., Lapchin L., Derridj S., Kim K.S., Reynaud P., Furlan L. & Guillemaud T. (2005) Multiple transatlantic introductions of the Western Corn Rootworm. *Science* 310: 992.

Vidal S., Kuhlmann U. & Edwards C.R. (2005) Western Corn Rootworm - Ecology and Management. CABI Publishing, Wallingford.

ARTICLE:

Open Letter for the establishment of a biological control expert group

by Stefan Toepfer
CABI Bioscience c/o Plant Health Service, Hodmezovasarhely, Hungary

Dear IWGO members and biological control experts

Within the next few months, a new network-project of the European Commission entitled „Harmonizing the strategies for fighting the Western Corn Rootworm (WCR): Diabrotica v. virgifera“ will start. The coordinators, Christoph Routier (Arvalis, France) and Stefan Vidal (Goettingen University, Germany), have described the project outline in detail in thisnewsletter.

In order to avoid project activities during the upcoming field season, we would like to take this early opportunity to ask you to provide us with some information regarding your area of work. We plan to use this information to establish a World Core Group of institutions and experts focusing on the biological control of WCR and other maize pests. Our specific aims are: (i) to survey current developments in European and worldwide biological control techniques against corn rootworms and other key maize pests using macro-organisms (predators, parasitoids, and nematodes) and micro-organisms (fungi, bacteria, viruses, etc.) through classical, augmentative or conservation biological control, (ii) to identify knowledge gaps and research needs to promote sustainable natural control options for the invasive alien WCR in Europe, (iii) to enforce the development of realistic and economically feasible biological control techniques, in combination with the other management options, for suppressing WCR populations, and (iv) to determine and harmonise key research actions needed to develop an action and a research plan for biological control options against WCR in Europe.

In order to establish a global list of experts we kindly ask all IWGO readers who work in the area of biological control of WCR and/or other maize pests to fill out the attached questionnaire. Moreover, we would appreciate your help in finding further experts that are currently not participating in the IWGO group. The outcome of this questionnaire, i.e. the global list of experts, will be published in a subsequent IWGO newsletter..

Thank for your efforts.
Yours sincerely,
Stefan Toepfer

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Fax to: +36-6-246036

St. Toepfer

Or send by post to S. Toepfer, CABI Bioscience c/o Plant Health Service, Rarosiut 110, H-6800 Hmvhely, Hungary

We kindly ask you to fill out the following questionnaire concerning your or your institution's activities relating to:

Biological Control of Maize Pests

Why :
Establishment of a public database of experts or units working on / interested in / using biological control techniques against maize pests worldwide.
Later: To determine the most promising approaches for biological control in maize-systems and highlight current gaps in knowledge and / or research activities.
Later: Propose a joint action plan (resembling a white paper) to the EU Commission.

Frame:
Specific EU Support Action on harmonising the strategies for fighting Diabrotica (SSA Diabr-ACT No 022623, 6th Framework programme Priority 8.1. Policy Oriented Research).

Please invest 10 minutes!

Describe your area of interest in a few words:

Please place a cross "x" in relevant box (multiple crosses possible)

Your Institution

Farmer Association	
Extension Service	
Research Institution	
Natl. Plant Protection Auth.	
Product Suppliers	
Industrial Enterprise	
Ministry of Agriculture	
Expert Consultancy	
Specify:	

Type of Work

Farmer	
Policy & regulation	
Training & education	
Extension	
Research & development	
Biocontrol SME	
Specify:	

Expert contact

Surname:
Name:
Position:
Institution:
Town:
Country:
Email:
Tel.:
Homepage:

Your Target Pest

Diabrotica v. virgifera	
Other Diabroticina	
Helicoverpa spp.	
Heliothis spp.	
Agriotes spp.	
Agrotis spp.	
Tanymecus spp.	
Spodoptera spp.	
Ostrinia spp.	
Fungal diseases	
Specify:	

Your Area of Expertise

Organic farming practice	
IPM practice	
Subsidy regulations	
IPM regulations	
Biological control agents	
Classical biocontrol	
Augmentative biocontrol	
Conservation biocontrol	
Weed biocontrol	
Cultural control	
Specify:	

Control Agent

Predators	
Parasitoids	
Nematodes	
Fungi	
Protozoa	
Virus	
Bacteria	
Other Biopesticides	
Specify:	

Comments

Can you suggest other experts (e.g. practical experts, farmer assoc., advisors) to be contacted?

Name: Email: Institution:
Name: Email: Institution:

Thank you very much for your efforts. We will provide the final list as soon as possible.

Questions? -: Stefan Toepfer; stoepfer@gmx.net; Tel. 0036 62 535740

IWGO WCR Bibliography 2005

References found for western corn rootworm, *Diabrotica virgifera virgifera*, until November 2005 are presented. E-mail addresses of the first or corresponding author available have been added so that you can easily request a PDF from the corresponding author.

Screening of entomopathogenic nematodes for virulence against the invasive western corn rootworm, *Diabrotica virgifera virgifera* (Coleoptera: Chrysomelidae) in Europe.
AU: Toepfer,-S; Gueldenzoph,-C; Ehlers,-R-U; Kuhlmann,-U
AD: CABI Bioscience Switzerland Centre, Rue des Grillons 1, 2800 Delemont, Switzerland.
EM: u.kuhlmann@cabi.org
SO: Bulletin-of-Entomological-Research. 2005; 95(5): 473-482
PY: 2005
LA: English
AB: Entomopathogenic nematode species available in Europe were screened for their efficacy against both the root-feeding larvae and silk-feeding adults of the western corn rootworm, Diabrotica virgifera virgifera LeConte. Laboratory screening tests were aimed at the selection of candidate biological control agents for the management of this invasive alien pest in Europe. Steinernema glaseri, S. arenarium, S. abassi, S. bicornutum, S. feltiae, S. kraussei, S. carpocapsae and Heterorhabditis bacteriophora were studied to determine their virulence against third instar larvae and adults of D. v. virgifera in small-volume arenas (using nematode concentrations of 0.5, 0.8, 7.9 and 15.9 infective juveniles cm-2). All nematode species were able to invade and propagate in D. v. virgifera larvae, but adults were rarely infected. At concentrations of 7.9 and 15.9 cm2, S. glaseri, S. arenarium, S. abassi and H. bacteriophora caused the highest larval mortality of up to 77%. Steinernema bicornutum, S. abassi, S. carpocapsae and H. bacteriophora appeared to have a high propagation level, producing 5970±779, 559±811, 5341±1177 and 4039±1025 infective juveniles per larva, respectively. Steinernema glaseri, S. arenarium, S. feltiae, S. kraussei and H. bacteriophora were further screened at a concentration of 16.7 nematodes cm-2 against third instar larvae in medium-volume arenas (sand-filled trays with maize plants). Heterorhabditis bacteriophora, S. arenarium and S. feltiae caused the highest larval mortality with 77+or-16.6%, 67+or-3.5%, and 57+or-17.1%, respectively. In a next step, criteria for rating the entomopathogenic nematode species were applied based on results obtained for virulence and propagation, and for current production costs and availability in Europe. These criteria were then rated to determine the potential of the nematodes for further field testing. Results showed the highest potential in H. bacteriophora, followed by S. arenarium and S. feltiae, for further testing as candidate biological control agents..

Baseline susceptibility of western corn rootworm (Coleoptera: Crysomelidae) to Cry3Bb1 *Bacillus thuringiensis* toxin.
AU: Siegfried,-B-D; Vaughn,-T-T; Spencer,-T
AD: Department of Entomology, 202 Plant Industry Building, University of Nebraska, Lincoln, NE 68583-0816, USA.
SO: Journal-of-Economic-Entomology. 2005; 98(4): 1320-1324
PY: 2005
LA: English
AB: Susceptibility to Cry3Bb1 toxin from Bacillus thuringiensis (Bt) was determined for western corn rootworm, Diabrotica virgifera virgifera LeConte, neonates from both laboratory and field populations collected from across the Corn Belt. Rootworm larvae were exposed to artificial diet treated with increasing Cry3Bb1 concentrations, and mortality and growth inhibition were evaluated after 4-7 d. The range of variation in Bt susceptibility indicated by growth inhibition was similar to that indicated by mortality. Although interpopulation variation in susceptibility was observed, the magnitude of the differences was comparable with the variability observed between generations of the same population.

In general, the toxin was not highly toxic to larvae and estimated LC50 and EC50 values were several times higher than those reported for lepidopteran-specific Cry toxins by using similar bioassay techniques. These results suggest that the observed susceptibility differences reflect natural variation in Bt susceptibility among rootworm populations and provide a baseline for estimating potential shifts in susceptibility that might result from selection and exposure to Cry3Bb1-expressing corn hybrids.

Flight behavior of methyl-parathion-resistant and -susceptible western corn rootworm (Coleoptera: Chrysomelidae) populations from Nebraska.

AU: Stebbing,-J-A; Meinke,-L-J; Naranjo,-S-E; Siegfried,-B-D; Wright,-R-J; Chandler,-L-D

AD: Department of Entomology, University of Nebraska-Lincoln, 202 Plant Industry, Lincoln, NE 68583-0816, USA.

EM: lmeinke1@unl.edu

SO: Journal-of-Economic-Entomology. 2005; 98(4): 1294-1304

PY: 2005

LA: English

AB: Relative flight behavior of methyl-parathion-resistant and -susceptible western corn rootworm, Diabrotica virgifera virgifera LeConte populations, was studied as part of a larger effort to characterize the potential impact of insecticide resistance on adult life history traits and to understand the evolution and spread of resistance. A computer interfaced actograph was used to compare flight of resistant and susceptible individuals, and flight of resistant individuals with and without prior exposure to methyl-parathion. In each case, mean trivial and sustained flight durations were compared among treatments. In general, there were few differences in trivial or sustained flight characteristics as affected by beetle population, insecticide exposure, sex, or age and there were few significant interactions among variables. Tethered flight activity was highly variable and distributions of flight duration were skewed toward flights of short duration. Tethered flight activity was similar among resistant and susceptible beetles with the exception that susceptible beetles initiated more flights per beetle than resistant beetles. After sublethal exposure to methyl-parathion, total flight time, total trivial flight time, and mean number of flights per resistant beetle declined significantly. Because long-range flight was uncommon, short- to medium-duration flights may play an important role in determining gene flow and population spread of resistant D. v. virgifera. These results suggest that organophosphate-resistant beetles can readily move and colonize new areas, but localized selection pressure (e.g., management practices) and exposure to methyl-parathion may contribute to the small-scale differences in resistance intensity often seen in the field..

Insecticide enhancement with feeding stimulants in corn for western corn rootworm larvae (Coleoptera: Chrysomelidae).

AU: Bernklau,-E-J; Bjostad,-L-B

AD: Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523, USA.

SO: Journal-of-Economic-Entomology. 2005; 98(4): 1150-1156

PY: 2005

LA: English

AB: Amounts of the insecticide thiamethoxam required for 50% mortality of western corn rootworm larvae, Diabrotica virgifera virgifera LeConte, were reduced 100-fold when extracts of germinating corn, Zea mays L., were used to entice neonate larvae to feed on it. In behavioral bioassays, neonate rootworm larvae fed vigorously on filter paper disks treated with liquid pressed from corn roots. Moreover, disks treated with an acetone extract of corn (dried and rewetted with water) also elicited strong feeding from larvae. Larvae wandered away from filter paper disks treated with distilled water without feeding. Dilutions of thiamethoxam were tested in the bioassay alone or with corn extract and the efficacy of this insecticide was improved by the addition of the corn extract. For solutions containing 10 ppm thiamethoxam, 95% larval mortality occurred after 30 min of exposure when corn extract was present, but only 38% mortality occurred when the same concentration of insecticide alone (no feeding stimulants) was tested. Larval mortality after 24 h was significantly higher for corn extract-treated disks with 0.01, 0.1, 1, or 10 ppm insecticide than for the same concentrations without corn extract. Thiamethoxam did not deter larval feeding on corn extract, even at the highest concentration of thiamethoxam tested.

Effect of Cry3Bb1-expressing transgenic corn on plant-to-plant movement by western corn rootworm larvae (Coleoptera: Chrysomelidae).

AU: Hibbard,-B-E; Vaughn,-T-T; Oyediran,-I-O; Clark,-T-L; Ellersieck,-M-R

AD: USDA-ARS, Plant Genetics Research Unit, 205 Curtis Hall, University of Missouri, Columbia, MO 65211, USA.

SO: Journal-of-Economic-Entomology. 2005; 98(4): 1126-1138

PY: 2005

LA: English

AB: Dispersal of larvae of the western corn rootworm, Diabrotica virgifera virgifera LeConte, in specific combinations of transgenic corn expressing the Cry3Bb1 protein and nontransgenic, isoline corn was evaluated in a 2-yr field study. In total, 1,500 viable western corn rootworm eggs were infested in each subplot. Each year, plant damage and larval recovery were evaluated among four pedigree combinations (straight transgenic; straight nontransgenic corn; nontransgenic corn with a transgenic central, infested plant; and transgenic corn with a nontransgenic central, infested plant) on six sample dates between egg hatch and pupation. For each subplot, the infested plant, three successive plants down the row (P1, P2, and P3), the closest plant in the adjacent row of the plot, and a control plant were sampled. The number of western corn rootworm larvae recovered from transgenic rootworm-resistant plants adjacent to infested nontransgenic plants was low and not statistically significant in either 2001 or 2002. In 2001, significantly fewer larvae were recovered from transgenic rootworm-resistant plants than from nontransgenic plants when both were adjacent to infested, nontransgenic plants. In 2002, significantly more neonate western corn rootworm larvae were recovered from nontransgenic plants adjacent to infested, transgenic rootworm-resistant plants than nontransgenic plants adjacent to infested, nontransgenic plants on the second sample date. Together, these data imply that both neonate and later instar western corn rootworm larvae prefer nontransgenic roots to transgenic rootworm-resistant roots when a choice is possible. However, when damage to the infested, nontransgenic plant was high, western corn rootworm larvae apparently moved to neighboring transgenic rootworm-resistant plants and caused statistically significant, although only marginally economic, damage on the last sample date in 2001. Implications of these data toward resistance management plan are discussed..

***Trichogramma brassicae* and SLAMReg., an integrated approach to managing European corn borer and corn rootworms.**

AU: Lewis,-L-C; Gunnarson,-R-D; Robbins,-J-C

AD: United States Department of Agriculture-Agricultural Research Service, Corn Insects and Crop Genetics Research Unit, Genetics Laboratory c/o Insectary Bldg., Ames, IA 50011, USA.

EM: leslewis@iastate.edu

SO: BioControl-. 2005; 50(5): 729-737

PY: 2005

LA: English

AB: European corn borer, Ostrinia nubilalis (Hubner) (Lepidoptera: Crambidae); western corn rootworm (WCRW), Diabrotica virgifera virgifera LeConte; and northern corn rootworm (NCRW), Diabrotica barberi (Smith & Lawrence) (Coleoptera: Chrysomelidae) are important pests of corn, Zea mays L., that occur simultaneously in the US Corn Belt. Areawide management strategies for northern and western corn rootworm in Iowa, Kansas, South Dakota, Illinois, and Indiana, and for the Mexican strain in Texas, use SLAMReg., which contains cucurbitacin, a feeding stimulant, and a small amount of the insecticide carbaryl. This management strategy is environmentally sound because it introduces a substantially lesser amount of chemical insecticide into the environment than prophylactic soil insecticide applications for WCRW management. To develop a management program for both corn pests, the compatibility of SLAMReg. to control CRW, along with a biological agent to manage European corn borer, was investigated. Laboratory studies were conducted using the egg parasitoid Trichogramma brassicae (Bezdenko) (Hymenoptera: Trichogrammatidae). In experiments in which SLAMReg. and T. brassicae were evaluated as components of a management system, SLAMReg. did not affect parasitism or parasitoid emergence rates. Trichogramma brassicae displayed vigorous biotic fitness, emergence rates, sex ratios, and fecundity over the duration of the study. Data collected under these laboratory conditions indicated that SLAMReg. had no adverse effect on the quality of T. brassicae, indicated by its ability to reproduce in the filial generation..

Occurrence of major pests in field crops in Vojvodina in 2004 and forecasts for 2005.
OT: Pojava vaznijih stetocina ratarskih biljaka u Vojvodini 2004. I prognoza pojave 2005. Godine.
AU: Keresi,-T; Sekulic,-R; Stamenkovic,-S-(et-al)
AD: Faculty of Agriculture, Novi Sad, Serbia and Montenegro.
SO: Biljni-Lekar-Plant-Doctor. 2005; 33(1): 23-34
PB: Novi Sad, Serbia and Montenegro: Faculty of Agriculture, Department for Environmental and Plant Protection, University of Novi Sad.
PY: 2005
LA: Serbian
LS: English
AB: Forecasts of the occurrence of major field crop pests in Vojvodina Province, Serbia, have been regularly reported since 1978. The analysis of soil samples from fields where cereals and sugarbeet were grown in 2004 revealed the presence of wireworms (Elateridae; average density of 3.1/m2), white grubs (Scarabaeidae; 0.4/m2), larvae of Scotia [Agrotis] spp. (0.13/2), adults of Bothynoderes punctiventris (1.0/m2) and chrysalides of Mamestra spp. (0.2/m2). In late autumn, 41.2 adults of sunn pests (Eurygaster and Aelia)/m2 were found in overwintering sites. The number of cotton bollworm (Helicoverpa armigera) and injury caused by this pest significantly decreased in 2004. The number of Ostrinia nubilalis and Diabrotica virgifera virgifera, and damage caused by these pests were similar or slightly greater than those recorded during the previous year..

Suitability of different fluorescent powders for mass-marking the Chrysomelid, *Diabrotica virgifera virgifera* LeConte.
AU: Toepfer,-S; Levay,-N; Kiss,-J
AD: Plant Protection Department, St. Istvan University, Godollo, Hungary.
EM: stoepfer@gmx.net
SO: Journal-of-Applied-Entomology. 2005; 129(8): 456-464
PY: 2005
LA: English
AB: The Western Corn Rootworm, Diabrotica virgifera virgifera LeConte (Col., Chrysomelidae), is an invasive alien pest of maize, Zea mays, in Europe. The suitability of 14 fluorescent powders for mass-marking the adults was studied in laboratory and in field cages. The visual discrimination between remaining spots of each colour on the beetles was investigated under ultraviolet (UV) light, as well as their retention time and the influences of those colours on the beetle survival and flight take-off response. The two best recognizable orange colours (i.e. of Radiant Colour and of Fiesta Colours Swada) were proposed for field experiments in first priority, followed by an orange and a yellow (both Magruder Colour), another yellow (Fiesta) and a pink (Radiant), as all did not affect beetle survival and flight take-off response and were recognizable under UV light for at least 10 days in the field. In contrast, the colours yellow and green (Radiant), red and blue (Magruder), yellow (Ciba Geigy) and pink (Fiesta) were unsuitable, because they either quickly disappeared from the beetles or adversely affected beetle survival or flight take-off response. For mass releases with differently marked beetles, only the use of a single orange colour together with a single yellow colour or the use of a pink colour together with a yellow colour can be used since few spots can clearly be discriminated from each other under UV light..

Economic analysis of dynamic management strategies utilizing transgenic corn for control of western corn rootworm (Coleoptera: Chrysomelidae).

AU: Crowder,-D-W; Onstad,-D-W; Gray,-M-E; Mitchell,-P-D; Spencer,-J-L; Brazee,-R-J
AD: Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL 61801, USA.
EM: dcrowder@ag.arizona.edu
SO: Journal-of-Economic-Entomology. 2005; 98(3): 961-975
PY: 2005
LA: English
AB: We studied management strategies for western corn rootworm, Diabrotica virgifera virgifera LeConte, using transgenic corn, Zea mays L., from both a biological and an economic perspective. In areas with and without populations adapted to a 2-yr rotation of corn and soyabean (rotation-resistant), the standard management strategy was to plant 80% of a cornfield (rotated and continuous) to a transgenic cultivar each year. In each area, we also studied dynamic management strategies where the proportion of transgenic corn increased over time in a region. We also analysed management strategies for a single field that is the first to adopt transgenic corn within a larger unmanaged region. In all areas, increasing the expression of the toxin in the plant increased economic returns. In areas without rotation-resistance, planting 80% transgenic corn in the continuous cornfield each year generated the greatest returns with a medium toxin dose or greater. In areas with alleles for rotation-resistance at low initial levels, a 2-yr rotation of nontransgenic corn and soyabean, Glycine max (L.) Merr., may be the most economical strategy if resistance to crop rotation is recessive. If resistance to crop rotation is additive or dominant, planting transgenic corn in the rotated cornfield was the most effective strategy. In areas where rotation-resistance is already a severe problem, planting transgenic corn in the rotated cornfield each year was always the most economical strategy. In some cases the strategies that increased the proportion of transgenic corn in the region over time increased returns compared with the standard strategies. With these strategies the evolution of resistance to crop rotation occurred more rapidly but resistance to transgenic corn was delayed compared with the standard management strategy. In areas not managed by a regional norm, increasing the proportion of transgenic corn and increasing toxin dose in the managed field generally increased returns. In a sensitivity analysis, among the parameters investigated, only density-dependent survival affected the results..

Strategies for controlling western corn rootworm (*Diabrotica virgifera virgifera*).

AU: Szell,-E; Zseller,-I; Ripka,-G; Kiss,-J; Princzinger,-G
AD: Cereal Research Non-Profit Co., Szeged, Hungary.
SO: Acta-Agronomica-Hungarica. 2005; 53(1): 71-79
PB: Budapest, Hungary: Akademiai Kiado.
PY: 2005
LA: English
AB: Small-plot trials in Szeged and large-scale trials in Mezohegyes, Hungary, were started in 1996 to elaborate strategies to control the western corn rootworm, Diabrotica virgifera virgifera (WCR). At the same time, monitoring was begun on when and where the insect appeared and in what numbers. The experiments were adapted to the life cycle of the species. WCR has one generation per year, laying ova that overwinter. Larvae begin to hatch in late May to mid-June. Adults emerge by mid-July and survive till early October. They lay ova in abundance from mid-July to late August. Trials were conducted to control WCR both with and without chemicals. For adult control, pesticides were sprayed from an aircraft or using a field sprayer. Larval control involved seed treatment with insecticide or the use of soil insecticide at planting or at cultivation..

The western corn rootworm *Diabrotica virgifera virgifera* Le Conte (Col., Chrysomelidae) in Britain: distribution, description and biology.

AU: Ostoja-Starzewski,-J-C
AD: Central Science Laboratory, Sand Hutton, York YO41 1LZ, UK.
SO: Entomologist'-s-Monthly-Magazine. 2005; 141(1694/96): 175-182
PY: 2005
LA: English
AB: The western corn rootworm beetle, *Diabrotica virgifera virgifera* Le Conte, is reported from Britain for the first time. Adults were found on five holdings in south-east England during the course of a limited survey using pheromone and kairomone baited sticky traps. The current distribution, description and biology of this species are discussed..

Interactions among western corn rootworm (Coleoptera: Chrysomelidae), yellow foxtail, and corn.

AU: Ellsbury,-M-M; Banken,-K-R; Clay,-S-A; Forcella,-F
AD: Northern Grain Insects Research Laboratory, USDA-ARS, 2923 Medary Ave. Brookings, SD 57006, USA.
EM: mellsbur@ngirl.ars.usda.gov
SO: Environmental-Entomology. 2005; 34(3): 627-634
PY: 2005
LA: English
AB: Field studies at sites with two contrasting soil types investigated effects from the presence of yellow foxtail [Setaria pumila (Poir.) Roem. and Schult.], established in bands parallel to corn rows, on western corn rootworm (Diabrotica virgifera virgifera LeConte) survival, corn root injury, lodging, biomass production, and yield. Results suggested that the presence of foxtail as an alternate host influenced the degree and progression of corn rootworm damage and adult emergence in a given locality. Rootworm adults emerged later from foxtail band areas and had smaller head capsule size than did individuals from areas without foxtail, consistent with earlier findings that foxtail in the diet of western corn rootworm was a poor nutritional substitute for corn. Lodging was reduced in the presence of yellow foxtail in some cases, but corn stover biomass and yield also were lower. Influences, if any, of soil type on rootworm survival were unclear because of differences in planting date between the two sites. Foxtail may function as a buffer to reduce rootworm damage to corn and serves as an alternate host that should be considered in the development of resistance management strategies for transgenic corn modified for rootworm resistance..

Effect of Bt corn expressing the Cry3Bb1 toxin on western corn rootworm (Coleoptera: Chrysomelidae) biology.

AU: Al-Deeb,-M-A; Wilde,-G-E
AD: Department of Entomology, Kansas State University, Manhattan, KS 66506-4004, USA.
SO: Journal-of-the-Kansas-Entomological-Society. 2005; 78(2): 142-152
PY: 2005
LA: English
AB: In Kansas, the western corn rootworm, Diabrotica virgifera virgifera LeConte (Coleoptera: Chrysomelidae), is one of the most economically important pests of corn. Crop losses and control costs attributed to Diabrotica spp. reach $1 billion annually in the U.S. Recently, Bt corn hybrids resistant to western corn rootworm larval damage have been field-tested for rootworm control. This study evaluated the effect of a specific Bt corn (YieldGard RootwormReg.) for corn rootworm control on larval survival. Elytra length, fecundity, percent egg hatch, and longevity of adult D. v. virgifera that survived exposure to Bt corn in the larval stage were also evaluated. Two groups of D. v. virgifera adults were assessed. One group had emerged from Bt and non-Bt corn roots; the other group was obtained from a colony with no larval exposure to Bt corn and fed Bt or non-Bt corn silk and ears. Bt corn significantly reduced the number of D. v. virgifera beetles emerging from corn roots. In general, Bt corn had no significant effect on longevity, elytra length, and female fecundity of D. v. virgifera beetles emerging from Bt corn plants. Bt corn had no significant effect on longevity and female fecundity of D. v. virgifera beetles feeding only as adults on Bt corn silk and ears. In general, Bt corn had no effect on number of D. v. virgifera beetles feeding in the field on corn silk and on silk damage caused by adults. Generally, the

results of this study demonstrated that Bt corn (MON 863) expressing the Cry3Bb1 toxin was extremely effective in reducing damage caused by D. v. virgifera larvae and had no significant effects on the longevity of beetles emerging from YieldGard RootwormReg. corn..

Effectiveness of recombinant soybean cysteine proteinase inhibitors against selected crop pests.

AU: Lalitha,-S; Shade,-R-E; Murdock,-L-L; Bressan,-R-A; Hasegawa,-P-M; Nielsen,-S-S
AD: 974 Bidwell Avenue, Sunnyvale, CA 94086, USA.
EM: nielsens@purdue.edu
SO: Comparative-Biochemistry-and-Physiology-C,-Toxicology-and-Pharmacology. 2005; 140(2): 227-235
PY: 2005
LA: English
AB: Three recombinant soybean cysteine proteinase inhibitors (rSCPIs), L1, R1 and N2, were assessed for their potential to inhibit the growth and development of three major agricultural crop pests known to utilize digestive cysteine proteinases: Western corn rootworm (Diabrotica virgifera virgifera, WCR), Colorado potato beetle (Leptinotarsa decemlineata, CPB) and cowpea weevil (Callosobruchus maculatus, CW). In vitro experiments showed that cysteine proteinase activities in the crude gut extracts of the WCR, CPB, and CW were inhibited to various degrees by the three rSCPIs. Of the three rSCPIs tested, N2 was most effective in inhibiting the crude gut extract of WCR, CPB, and CW (50% inhibition at 5x10-8, 5x10-8, and 3x10-7 M, respectively). The L1 was the least potent of the three CPIs tested, with 50% inhibition at 5x10-6 M of the crude gut extracts of WCR. Results of in vivo experiments conducted to assess the effect of the three rSCPIs on the vital growth parameters of WCR, CPB and CW were consistent with results of the in vitro experiments..

Effects of proteinase inhibitors on western corn rootworm life parameters.

AU: Bazok,-R; Barcic,-J-I; Edwards,-C-R
AD: Department for Agricultural Zoology, Faculty of Agriculture, University of Zagreb, Svetosimunska 25, Zagreb 10000, Croatia.
EM: rbazok@agr.hr
SO: Journal-of-Applied-Entomology. 2005; 129(4): 185-190
URL: http://www.blackwell-synergy.com/servlet/useragent?func=showIssues&code=jen
PY: 2005
LA: English
AB: Plants have developed defensive mechanisms to minimize predation by insect pests. Proteinase inhibitors are an example of plant compounds synthesized as a mechanism for defence. The objective of this study was to determine the impact of trans-epoxysuccinyl-L-leucylamido (4-guanidino) butane (E-64), phenylmethylsulfonyl fluoride (PMSF-serine protenase inhibitor) and Kunitz trypsin inhibitors on the pre-ovipositional and ovipositional periods, the mean number of eggs laid per female, and the longevity of western corn rootworm (WCR), Diabrotica virgifera virgifera LeConte, adults. This study provides information on the effectiveness of proteinase inhibitors as a host-plant resistance tool for managing WCR beetles. The study was conducted in 1997, 1998, and 2000. In 1997, E-64 was added to an artificial diet at the concentrations of 0.05, 0.025 and 0.0125% (w/w), corresponding to 500, 250, and 125 ppm respectively. In 1998, PMSF was added to the artificial diet at the same concentrations. In 2000, Kunitz trypsin inhibitor was added to the artificial diet at concentrations of 0.2, 0.1 and 0.05% (w/w), corresponding to 2000, 1000, and 500 ppm respectively. The mean fecundity of beetles fed the untreated diet was between 67 and 111 eggs per female. The fecundity of beetles fed E-64 and PMSF at different concentrations, ranged between 162 and 246 eggs per female for E-64 and 61 and 80.5 eggs per female for PMSF. The fecundity of the beetles fed Kunitz trypsin inhibitor was between 155 and 225 eggs per female. When beetles fed on the diet which consisted of the lowest dosage of Kunitz trypsin inhibitor (500 ppm), fecundity was higher than that on untreated control. The proteinase inhibitors investigated did not show a negative impact on WCR adults. Beetle fecundity, the length of the pre-ovipositional and ovipositional periods and the longevity of the beetles fed with proteinase inhibitors were not lower than that of the beetles fed only the artificial diet. This study does not support

the use of investigated proteinase inhibitors at applied concentrations as effective host-plant resistance tools for managing WCR beetles..

Distribution of western and northern corn rootworms (Coleoptera: Chrysomelidae) in Quebec, Canada.

AU: Meloche,-F; Rhainds,-M; Roy,-M; Brodeur,-J
AD: Agriculture and Agri-Food Canada, Eastern Cereal and Oilseed Research Centre, Ottawa, Ontario K1A 0C6, Canada.
EM: fsaamrh@hermes.ulaval.ca
SO: Canadian-Entomologist. 2005; 137(2): 226-229
PY: 2005
LA: English
AB: An intensive survey was conducted in 2002 and 2003 to document the distribution of northern and western corn rootworms (Diabrotica barberi and D. virgifera virgifera, respectively) in major maize producing regions in Quebec (Bas-Saint-Laurent, Centre-du-Quebec, Chaudiere-Appalaches, Estrie, Lanaudieve, Laurentides, Mauricie, Monteregie, Outaouais and Saguenay-Lac-Saint-Jean). The survey was conducted in fields of continuously grown maize and included 29 sites sampled between 9 July and 9 September 2002 and 26 sites sampled between 15 July and 16 September 2003. Sampling was performed using four yellow Pherocon AM traps suspended in each field and changed every 7 to 22 days. Factorial ANOVA indicated that the abundance of corn rootworms was higher in 2003 than in 2002, and that northern corn rootworms were more abundant than western corn rootworms. The relative abundance of western and northern corn rootworms did not fluctuate between years. Multiple regression models comparing densities of northern and western corn rootworms as a function of spatial coordinates did not reveal any significant variation in the abundance of northern corn rootworms. In contrast, western corn rootworms were more abundant in Quebec, whereas their abundance did not fluctuate along a north-south axis. Regression analysis indicated no significant relationship between the abundances of northern and western corn rootworms in different locations in 2002, suggesting the absence of strong interactions between the species..

Analysis of the dynamics of adaptation to transgenic corn and crop rotation by western corn rootworm (Coleoptera: Chrysomelidae) using a daily time-step model.

AU: Crowder,-D-W; Onstad,-D-W; Gray,-M-E; Pierce,-C-M-F; Hager,-A-G; Ratcliffe,-S-T; Steffey,-K-L
AD: Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL 61801, USA.
SO: Journal-of-Economic-Entomology. 2005; 98(2): 534-551
PY: 2005
LA: English
AB: Western corn rootworm, Diabrotica virgifera virgifera LeConte, has overcome crop rotation in several areas of the north central United States. The effectiveness of crop rotation for management of corn rootworm has begun to fail in many areas of the midwestern United States, thus new management strategies need to be developed to control rotation-resistant populations. Transgenic corn, Zea mays L., effective against western corn rootworm, may be the most effective new technology for control of this pest in areas with or without populations adapted to crop rotation. We expanded a simulation model of the population dynamics and genetics of the western corn rootworm for a landscape of corn; soybean, Glycine max (L.); and other crops to study the simultaneous development of resistance to both crop rotation and transgenic corn. Results indicate that planting transgenic corn to first-year cornfields is a robust strategy to prevent resistance to both crop rotation and transgenic corn in areas where rotation-resistant populations are currently a problem or may be a problem in the future. In these areas, planting transgenic corn only in continuous cornfields is not an effective strategy to prevent resistance to either trait. In areas without rotation-resistant populations, gene expression of the allele for resistance to transgenic corn, R, is the most important factor affecting the evolution of resistance. If R is recessive, resistance can be delayed longer than 15 yr. If R is dominant, resistance may be difficult to prevent. In a sensitivity analysis, results indicate that density dependence, rotational level in the landscape, and initial allele frequency are the three most important factors affecting the results..

Characterization of Cry34/Cry35 binary insecticidal proteins from diverse *Bacillus thuringiensis* strain collections.

AU: Schnepf,-H-E; Lee,-S; Dojillo,-J; Burmeister,-P; Fencil,-K; Morera,-L; Nygaard,-L; Narva,-K-E; Wolt,-J-D
AD: Research and Development Laboratories, Dow AgroSciences, Indianapolis, Indiana, USA.
EM: eschnep1@san.rr.com
SO: Applied-and-Environmental-Microbiology. 2005; 71(4): 1765-1774
PY: 2005
LA: English
AB: Bacillus thuringiensis crystal proteins of the Cry34 and Cry35 classes function as binary toxins showing activity on the western corn rootworm, Diabrotica virgifera virgifera LeConte. We surveyed 6,499 B. thuringiensis isolates by hybridization for sequences related to cry35A genes, identifying 78 strains. Proteins of the appropriate molecular mass (ca. 44 kDa) for Cry35 were observed in 42 of the strains. Full-length, or nearly full-length, sequences of 34 cry34 genes and 16 cry35 genes were also obtained from cloning, PCR analysis, and DNA sequencing. These included representatives of all known Cry34A, Cry34B, Cry35A, and Cry35B classes, as well as a novel Cry34A/Cry35A-like pair. Bioassay analysis indicated that cry35-hybridizing strains not producing a ca. 14-kDa protein, indicative of Cry34, were not active on corn rootworms, and that the previously identified Cry34A/Cry35A pairs were more active than the Cry34B/Cry35B pairs. The cry35-hybridizing B. thuringiensis strains were found in locales and materials typical for other B. thuringiensis strains. Comparison of the sequences with the geographic origins of the strains showed that identical, or nearly identical, sequences were found in strains from both Australasia and the Americas. Sequence similarity searches revealed that Cry34 proteins are similar to predicted proteins in Photorhabdus luminescens and Dictyostelium discoidium, and that Cry35Ab1 contains a segment similar to beta-trefoil domains that may be a binding motif. The binary Cry34/Cry35 B. thuringiensis crystal proteins thus appear closely related to each other, are environmentally ubiquitous, and share sequence similarities consistent with activity through membrane disruption in target organisms..

Genetic structuring of western corn rootworm (Coleoptera: Chrysomelidae) populations in the United States based on microsatellite loci analysis.

AU: Kim,-K-S; Sappington,-T-W
AD: USDA-ARS, CICGRU, Genetics Laboratory, Iowa State University, Ames, IA 50011, USA.
EM: tsapping@iastate.edu
SO: Environmental-Entomology. 2005; 34(2): 494-503
PY: 2005
LA: English
AB: The western corn rootworm (Diabrotica virgifera virgifera LeConte) (Coleoptera: Chrysomelidae) is a major corn insect pest in North America and is spreading in Europe. Seven polymorphic microsatellite loci were surveyed to characterize genetic structuring of D. v. virgifera populations, based on 595 individuals sampled from 10 locations across nine U.S. states (western Texas and Kansas to New York and Delaware). All populations showed high levels of genetic diversity, with mean allelic diversity ranging from 7.3 to 8.6, and mean expected heterozygosity ranging from 0.600 to 0.670. D. v. virgifera populations exhibited little genetic differentiation as a whole across the geographic range sampled, with a global FST of only 0.006. Pairwise FST estimates also revealed little genetic differentiation among populations. Most pairwise FST values were nonsignificant, except for those estimated between the Texas population and all others. There was a positive correlation between genetic distance and geographic distance as a whole, but no significant correlation for populations from Kansas to the east coast. There was no evidence for a genetic bottleneck in any D. v. virgifera population sampled. Phylogenetic and principal component analyses support the picture of high genetic similarity over much of the United States. Although high migration rates could produce the same pattern and cannot be ruled out, it seems more likely that the D. v. virgifera populations sampled have had insufficient time for substantial genetic structuring to develop since its recent eastward range expansion from the Great Plains that began ~50 yr ago..

Recruitment of entomopathogenic nematodes by insect-damaged maize roots.
AU: Rasmann,-S; Kollner,-T-G; Degenhardt,-J; Hiltpold,-I; Toepfer,-S; Kuhlmann,-U; Gershenzon,-J; Turlings,-T-C-J
AD: Laboratory of Animal Ecology and Entomology, Institute of Zoology, University of Neuchatel, C.P. 2, CH-2007 Neuchatel, Switzerland.
EM: ted.turlings@unine.ch
SO: Nature-London. 2005; 434(7034): 732-737
PY: 2005
LA: English
AB: Plants under attack by arthropod herbivores often emit volatile compounds from their leaves that attract natural enemies of the herbivores. Here we report the first identification of an insect-induced belowground plant signal, (E)- beta -caryophyllene, which strongly attracts an entomopathogenic nematode. Maize roots release this sesquiterpene in response to feeding by larvae of the beetle Diabrotica virgifera virgifera, a maize pest that is currently invading Europe. Most North American maize lines do not release (E)- beta -caryophyllene, whereas European lines and the wild maize ancestor, teosinte, readily do so in response to D. v. virgifera attack. This difference was consistent with striking differences in the attractiveness of representative lines in the laboratory. Field experiments showed a fivefold higher nematode infection rate of D. v. virgifera larvae on a maize variety that produces the signal than on a variety that does not, whereas spiking the soil near the latter variety with authentic (E)- beta -caryophyllene decreased the emergence of adult D. v. virgifera to less than half. North American maize lines must have lost the signal during the breeding process. Development of new varieties that release the attractant in adequate amounts should help enhance the efficacy of nematodes as biological control agents against root pests like D. v. virgifera..

Flight phenology of western corn rootworm (*Diabrotica virgifera virgifera*) in Switzerland South of the Alps.
OT: Phenologie du vol de la chrysomele des racines du mais (Diabrotica virgifera virgifera) dans le sud des Alpes suisses.
AU: Derron,-J-O; Bertossa,-M; Brunetti,-R; Colombi,-L
AD: Agroscope RAC Changins, case postale 254, CH-1260 Nyon 1, Switzerland.
EM: jacques.derron@rac.admin.ch
SO: Revue-Suisse-d'-Agriculture. 2005; 37(2): 61-64
PY: 2005
LA: French
LS: German; English; Italian
AB: An extensive trapping network was established after the first detection in 2000 of Diabrotica virgifera virgifera in Switzerland, close to Lugano. The observations of 2001 to 2003 in the Tessin were used to describe the flight phenology of this pest. A model of the beginning of flight, based on soil temperature above 10,5 degrees C, predicts the first emergence of the adults at 620 day-degrees. The observations indicate that the first adults of fields containing their own larval population (monoculture) emerge at 600+or-40 day-degrees. In uninfested fields (crop rotation), adults are captured 200 day-degrees later (about 15 days). Average captures per trap are 4 times higher on traps in monoculture fields than in rotated fields. Female flight period is longer than the male one..

Immunological assessment of an insecticide resistance-associated esterase in the Western corn rootworm.
AU: Zhou,-X-G; Scharf,-M-E; Meinke,-L-J; Chandler,-L-D; Siegfried,-B-D
AD: Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611, USA.
EM: bsiegfried1@unl.edu
SO: Archives-of-Insect-Biochemistry-and-Physiology. 2005; 58(3): 157-165
URL: http://www3.interscience.wiley.com/cgi-bin/abstract/109925851/ABSTRACT
DOI: doi:10.1002/arch.20040
PY: 2005
LA: English

AB: In previous investigations, we have determined that organophosphate resistance in the western corn rootworm, Diabrotica virgifera virgifera, is at least partially attributed to a group of non-specific carboxylesterases referred to as group II. Antiserum raised against a purified 66-kDa group II esterase is specific for the denatured enzyme. This antiserum reacts similarly with both beetle homogenates from resistant and susceptible populations, although there is much higher signal intensity in immunoblots of resistant relative to susceptible beetles. These results suggest that overproduction of group II esterases is the underlying basis of esterase-mediated resistance in D. v. virgifera by demonstrating that (1) group II esterases are immunologically indistinguishable between the resistant and susceptible populations, and (2) the intensity differences are due to increased group II esterase proteins in the resistant population. The diagnostic potential of immunological-based assays was tested with a traditional diagnostic concentration bioassay and a biochemical-based native PAGE assay. Significant correlations were observed among all three diagnostic assays (regression coefficients ranging from 0.95 to 0.96). These results demonstrate the importance of the 66-kDa protein as a resistance-associated biochemical marker, thus emphasizing the potential for 66-kDa protein-targeted immunoassays in resistance monitoring programs..

Experience of corn rootworm control (*Diabrotica virgifera virgifera* LeConte) by new applicator of granular insecticide in sowing.
OT: Iskustvo suzbijanja kukuruzne zlatice (Diabrotica virgifera virgifera LeConte) novim deponatorom insekticida.
AU: Zimmer,-R; Ivezic,-M; Raspudic,-E; Simunic,-R; Jalsovec,-Z
ED: Kosutic,-S
AD: Poljoprivredni fakultet Osijek, Trg Sv. Trojstva 3, 31000 Osijek, Croatia.
EM: zimmer@pfos.hr
SO: Aktualni-zadaci-mehanizacije-poljoprivrede-Zbornik-radova,-33-meunarodnog-simpozija-iz-podruja-mehanizacije-poljoprivrede,-Opatija,-Croatia,-21-25-veljae-2005. 2005; 463-468
PY: 2005
LA: Croatian
LS: English
AB: Corn rootworm (D. virgifera virgifera) infesting maize cv. OSSK 596 was chemically controlled using a new applicator of granular insecticide. Granular insecticides were deposited in tracks (10-12 cm width) above the seed, after the passage of the pushing wheel and before the seed-mould machine. Sowing, in which seed was treated with Geocin ST-35 emulsion was accomplished with turned off UZP device. Geocid G-5 and Dursban G-7.5 were used at 15 and 25 kg/ha, respectively. Liquid insecticide Geocid ST-35 KSJ was applied at 3 litre/100 kg seed. Damage evaluation on roots was assessed using the Node injury scale (0-3)..
DE: applicators-; chemical-control; insect-control; insect-pests; insecticides-; maize-; methodology-; pest-control; plant-pests; roots-; techniques-

Study on the flight and establishment of western corn rootworm (*Diabrotica virgifera virgifera* LeConte) in County Somogy carried out in 2004.
OT: Az amerikai kukoricabogar (Diabrotica virgifera virgifera LeConte) 2004. Evi rajzas-es betelepedesvizsgalata Somogy megyeben.
AU: Keszthelyi,-S
AD: Department of Botany and Crop Production, Faculty of Animal Husbandry, Kaposvar University, H-7400 Kaposvar, Guba S. u. 40, Hungary.
SO: Novenyvedelem-. 2005; 41(3): 99-103
PB: Budapest, Hungary: Agroinform Kiado.
PY: 2005
LA: Hungarian
LS: English
AB: The appearance in 2004, establishment and the need for the control of western corn rootworm made it necessary to observe flight of the pest. Therefore I carried out a trial with Pherocon AM pheromone traps in maize grown after sunflowers in a 111.1 hectare area in Hungary. I placed out 6

traps so that they get both to the edge and the inside of the field. I determined the effect of meteorological factors on the flight, comparing the climatic data characteristic of the area and the time. The pheromone trapping clearly shows a late-summer, single-peak flight of western corn rootworm beetles. The late-season mass flight can be attributed to the influence of climatic factors. In addition to the high population density towards the end of the cycle of vegetation of maize (the average number of trapped beetles was 141-142), I recorded the increasing share of females filled with eggs in the area (on 29 July: 25-28%; while on 5 August: 38-42%), predicting a mass outbreak of the next year's generation. The traps at the field margins caught more beetles than the ones placed inside the field (the average of ranking the traps in catching during the monitoring time at the margins were: 2.66; 2.77; 3 and 3.44; while in the case of the inside traps - it was 4,55 for both traps). This difference decreased towards the end of the flight..

Expressed sequence tags from *Diabrotica virgifera virgifera* midgut identify a coleopteran cadherin and a diversity of cathepsins.
AU: Siegfried,-B-D; Waterfield,-N; Ffrench-Constant,-R-H
AD: Department of Entomology, 202 Plant Industry Building, University of Nebraska-Lincoln, Lincoln, Nebraska, USA.
EM: bsiegfried1@unl.edu
SO: Insect-Molecular-Biology. 2005; 14(2): 137-143
PY: 2005
LA: English
AB: The Western corn rootworm is the major pest of corn in the USA and has recently become the target for insect-resistant transgenic crops. Transgenic crops have switched the focus for identifying insecticide targets from the insect nervous system to the midgut. Here we describe a collection of 691 sequences from the Western corn rootworm midgut, 27% of which predict proteins with no matches in current databases. Of the remaining sequences, most predict proteins with either catalytic (62%) or binding (19%) functions, as expected for proteins expressed in the insect midgut. The utility of this approach for the identification of targets for novel toxins is demonstrated by analysis of the first coleopteran cadherin gene, a putative Bt receptor, and a large class of cysteine-proteases, the cathepsins..

Spatial prediction of corn rootworm (Coleoptera: Chrysomelidae) adult emergence in Iowa cornfields.
AU: Park,-Y-L; Tollefson,-J-J
AD: Department of Entomology, University of California, Riverside, CA 92521, USA.
EM: yonglak@ucr.edu
SO: Journal-of-Economic-Entomology. 2005; 98(1): 121-128
PY: 2005
LA: English
AB: The most common management options for corn rootworms are rotating maize with nonhost crops, planting genetically engineered maize resistant to corn rootworms, Diabrotica virgifera virgifera and D. barberi (e.g., Bacillus thuringiensis, Bt, maize), and treating with a soil insecticide at planting time. Because these control tactics are preventive, the decision to apply controls has been made without any knowledge of rootworm density and spatial distribution. This study was conducted during 2000-01 and 2001-02 to predict the spatial distribution of adult emergence and to generate and test management zones for insecticides and Bt maize. To identify variables that correlated best with adult emergence the following year, plant height, plant stage, soil moisture, altitude, and corn rootworm adults were sampled spatially and temporally. Correlation and regression analyses showed that the best prediction for the adult emergence the following year was adult counts in the ear zone at peak population densities during the present year. Based on the prediction, geostatistics and the geographic information system were used to generate and test prescription maps with management zones for insecticides and Bt maize. Map-overlaying analysis showed that management zones for insecticides based on the economic injury level and Bt maize with 20% refuge had potential failure of 3-15 and 0-12% of field areas, respectively. This study demonstrated the spatial prediction of adult emergence the following year and generation of management zones, which has the potential of preventative, site-specific management of corn rootworms..

Node-injury scale to evaluate root injury by corn rootworms (Coleoptera: Chrysomelidae).
AU: Oleson,-J-D; Park,-Y-L; Nowatzki,-T-M; Tollefson,-J-J
AD: Department of Entomology, Iowa State University, Ames, IA 50011-3140, USA.
SO: Journal-of-Economic-Entomology. 2005; 98(1): 1-8
PY: 2005
LA: English
AB: Corn rootworm (Diabrotica barberi and D. virgifera virgifera) larval feeding on maize roots can significantly reduce grain yield by interfering with photosynthetic rates, limiting the uptake of water and nutrients, and by increasing the plant's susceptibility to lodging. Of the techniques developed to measure the efficacy of corn rootworm larval control tactics, root damage ratings have generally been adopted as the standard because sampling roots is relatively efficient. Historically, the primary scales used for scoring root injury from corn rootworm larval feeding have been the 1-6 and 1-9 scales. A critical deficiency of those scales, however, is that each increase in a root-rating score does not reflect a linear increase in the actual amount of injury to the root system. This results in injury scores that are expressed qualitatively. We developed the node-injury scale to more accurately quantify corn rootworm larval injury based on the proportion of nodal roots that contain feeding injury. With the node-injury scale, the relationship between the numerical scale and the amount of root injury is linear and intuitive. In this article, we describe the node-injury scale, discuss sampling issues to consider when using the scale, and suggest the minimum node-injury score that causes economic damage under varying degrees of environmental stress..

How to measure the food utilization of subterranean insects: a case study with the western corn rootworm (*Diabrotica virgifera virgifera*).
AU: Moeser,-J; Vidal,-S
AD: Institute for Plant Pathology and Plant Protection, Georg-August University Goettingen, Grisebachstr. 6, 37077 Goettingen, Germany.
EM: jmoeser@gwdg.de
SO: Journal-of-Applied-Entomology. 2005; 129(1): 60-63
PY: 2005
LA: English
AB: To date, nutritional studies on subterranean insects have focused on qualitative aspects due to experimental limitations. We have developed a method of studying insect-plant interactions quantitatively in subterranean environments. The initial and final weights of larvae of Diabrotica virgifera virgifera LeConte (Chrysomelidae, Galeruncinae) and those of maize roots, which served as food items were determined. The difference between initial and final weight of larvae and roots allowed for the calculation of the food conversion efficiency. This can be used to portray differences in food quality and its impact on larval performance and development..

Nutritional resources used by the invasive maize pest *Diabrotica virgifera virgifera* in its new South-east-European distribution range.
AU: Moeser,-J; Vidal,-S
AD: Georg-August University Goettingen, Institute for Plant Pathology and Plant Protection, Grisebachstr. 6, 37077 Goettingen, Germany.
EM: jmoeser@gwdg.de
SO: Entomologia-Experimentalis-et-Applicata. 2005; 114(1): 55-63
PY: 2005
LA: English
AB: Food utilization by adults of the invasive maize (Zea mays L.) (Poaceae) pest western corn rootworm (WCR; Diabrotica virgifera virgifera LeConte) (Coleoptera: Chrysomelidae) was investigated in the south-eastern part of its new European distribution range. At weekly intervals over a 10-week period, 10 beetles per field were collected from six fields that had a high abundance of flowering weeds and six fields with a low abundance of flowering weeds, with the aim of understanding adult feeding behaviour in Europe and comparing this behaviour with North American WCR. Gut content analysis was performed to determine the use of maize tissue and weed pollen with regard to maize phenology. Furthermore, all pollen found within the gut was quantified and identified to plant species level. The use of maize tissue by adult WCR changed over time according to maize phenology. Pollen originating from plants other than maize was used more frequently as the maize matured. Adults fed on pollen from 19

of 25 different plant species found in maize fields and showed a preference for the pollen of specific weeds. Pollen from weed species was found more often in beetles from fields with a high abundance of weeds compared to beetles from fields with a low abundance of weeds. Females consumed greater amounts of pollen than males, the latter feeding on a wider diversity of host plants. The pollen resources used by adult WCR in Hungary were more diverse compared to WCR in the USA, which may contribute to the invasion success of WCR in Europe..

Natural mortality factors acting on western corn rootworm populations: a comparison between the United States and Central Europe.
AU: Toepfer,-S; Kuhlmann,-U
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: CABI Bioscience Switzerland Centre, Rue des Grillons 1, 2800 Delemont, Switzerland.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 95-119
PY: 2005
LA: English
AB: This chapter provides details on natural mortality factors acting on the life stages of Diabrotica virgifera virgifera, and summarizes statistically reliable information compiled and published over the last 40 years. Reported information on mortality factors acting on the egg, larval, pupal and adult stages of D. virgifera virgifera in the USA have been compiled into comparable units and compared directly with the results obtained from similar life table studies on D. virgifera virgifera in Hungary, representing mortality factors in Central Europe..

Western corn rootworm, cucurbits and cucurbitacins.
AU: Tallamy,-D-W; Hibbard,-B-E; Clark,-T-L; Gillespie,-J-J
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Department of Entomology and Wildlife Ecology, University of Delaware, 250 Townsend Hall, Newark, DE 19717, USA.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 67-93
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: This chapter discusses the phylogenetic, evolutionary, ecological and applied implications of Western corn rootworm, Diabrotica virgifera virgifera, preference for cucurbits..

A synopsis of the nutritional ecology of larvae and adults of *Diabrotica virgifera virgifera* (LeConte) in the new and old world - nouvelle cuisine for the invasive maize pest *Diabrotica virgifera virgifera* in Europe?
AU: Moeser,-J; Hibbard,-B-E
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Institute for Plant Pathology and Plant Protection, Entomological Section, Georg-August University, Grisebachstrasse 6, 37077 Gottingen, Germany.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 41-65
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: This chapter focuses on the knowledge of Diabrotica virgifera virgifera nutritional ecology gained in its area of first appearance as a major maize pest (USA) and will be supplemented with the latest research from its expansion area in Europe. The major objectives of this chapter are: (i) to discuss the nutritional ecology of D. virgifera virgifera against the background of resistance management plant for genetically-modified maize and the developing resistance to insecticides and crop rotation, which have become major issues in USA agriculture during the last decade; and (ii) to provide an orientation for European researchers to understand the patterns behind the invasion process and for European maize producers to facilitate the implementation of integrated pest management strategies by summarizing the current knowledge on D. virgifera virgifera..

Monitoring of western corn rootworm (*Diabrotica virgifera virgifera* LeConte) in Europe 1992-2003.
AU: Kiss,-J; Edwards,-C-R; Berger,-H-K; Cate,-P; Cean,-M; Cheek,-S; Derron,-J; Festic,-H; Furlan,-L; Igrc-Barcic,-J; Ivanova,-I; Lammers,-W; Omelyuta,-V; Princzinger,-G; Reynaud,-P; Sivcev,-I; Sivicek,-P; Urek,-G; Vahala,-O
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Department of Plant Protection, Szent Istvan University, 2100 Godollo, Hungary.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 29-39
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: This chapter presents an overview of Western corn rootworm (WCR) monitoring in Europe from 1992 to 2003. The other topics covered include monitoring as a tool for multiple purposes and some characteristics of the spread of WCR in Europe..

Maize growing, maize high-risk areas and potential yield losses due to western corn rootworm (*Diabrotica virgifera virgifera*) damage in selected European countries.
AU: Baufeld,-P; Enzian,-S
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Federal Biological Research Centre for Agriculture and Forestry, Department for National and International Plant Health, Stahnsdorfer Damm 81, 14532 Kleinmachnow, Germany.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 285-302
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: Results are presented of an experiment conducted to analyse the distribution and proportion of maize production in relation to arable land in France, Germany, Italy, Austria, The Netherlands, Belgium, Switzerland and Luxembourg. The obtained data would form the basis for modelling yield losses and economic damage in high-risk areas in Europe..

Is classical biological control against western corn rootworm in Europe a potential sustainable management strategy?
AU: Kuhlmann,-U; Toepfer,-S; Feng-Zhang
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: CABI Bioscience Switzerland Centre, Rue des Grillons 1, 2800 Delemont, Switzerland.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 263-284
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: This chapter describes a 3-year study implemented to evaluate the potential of classical biological control as a sustainable management strategy for Diabrotica virgifera virgifera in Europe. It is divided into 4 sections applying the step-by-step approach for classical biological control and thereby provides results on: (i) the survey for natural enemies in the area of invasion; (ii) the foreign exploration for natural enemies in the area of origin; (iii) the suitability of candidate biological control agents; and (iv) the host specificity of the candidate biological control agents..

Application of the areawide concept using semiochemical-based insecticide baits for managing the western corn rootworm (*Diabrotica virgifera virgifera* LeConte) variant in the eastern Midwest.
AU: Gerber,-C-K; Edwards,-C-R; Bledsoe,-L-W; Gray,-M-E; Steffey,-K-L; Chandler,-L-D
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Department of Entomology, Purdue University, W. Lafayette, IN 47907-2089, USA.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 221-238
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English

AB: An areawide pest management (AWPM) programme was initiated in 1996 and data were collected during 1997-2002 to evaluate the Western corn rootworm (WCR) AWPM concept on the WCR variant located in northwestern Indiana and east-central Illinois, USA, with the use of semiochemical-based insecticide baits as the primary management strategy. The objectives were: to determine if a consistent decrease in the area requiring treatment with semiochemical-based baits occurred during the entirety of the programme; to determine if a consistent decrease in root damage by WCR larvae and a consistent decrease in WCR beetle emergence were detected from the beginning to the end of the programme; and to determine if the use of semiochemical-based insecticide baits to manage WCR adults provided a consistent yield benefit during the conduct of the programme. The results presented..

Western corn rootworm (*Diabrotica virgifera virgifera* LeConte) and the crop rotation systems in Europe.
AU: Kiss,-J; Komaromi,-J; Bayar,-K; Edwards,-C-R; Hatala-Zseller,-I
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Department of Plant Protection, Szent Istvan University, 2100 Godollo, Hungary.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 189-220
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: This chapter presents an overview on the hypotheses for the development of the new rotation-tolerant Western corn rootworm (WCR) variant, attraction of different crops to WCR adults and their feeding on non-maize crops, development of WCR adults in maize following different crops, and population level of WCT adults in different crop stands in the USA. Results are also presented of an experiment conducted in Hungary in 2000..

Sampling devices and decision rule development for western corn rootworm (*Diabrotica virgifera virgifera* LeConte) adults in soybean to predict subsequent damage to maize in Indiana.
AU: Gerber,-C-K; Edwards,-C-R; Bledsoe,-L-W; Obermeyer,-J-L; Barna,-G; Foster,-R-E
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Department of Entomology, Purdue University, W. Lafayette, IN 47907-2089, USA.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 169-187
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: Results are presented of experiments conducted during 1997, 1998, 1999 and 2000 in Indiana, USA, to develop a sampling programme for adult Western corn rootworm (WCR) in the maize/soyabean rotational system and to establish an economic injury level and an economic threshold based on WCR adult density estimates in soyabean for the potential damage created by WCR larvae in subsequent maize fields..

Heterogeneous landscapes and variable behaviour: modelling rootworm evolution and geographical spread.
AU: Onstad,-D-W; Guse,-C-A; Crowder,-D-W
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, IL 61801, USA.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 155-167
PB: Wallingford, UK: CAB International.
RE: 20 ref.
PY: 2005
LA: English
AB: This chapter describes a variety of models that help explain the current distribution on the rotation-resistant phenotype over geographical space and the evolution of Western corn rootworm, Diabrotica virgifera virgifera, to crop rotation, and examine strategies for delaying resistance to transgenic maize. Adult behaviour as a key component of evolution and geographical distribution in an ecological system are also demonstrated..

Movement, dispersal and behaviour of western corn rootworm adults in rotated maize and soybean fields.
AU: Spencer,-J-L; Levine,-E; Isard,-S-A; Mabry,-T-R
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Center for Economic Entomology, Illinois Natural History Survey, 172 Natural Resources Building, 607 E. Peabody Drive, Champaign, IL 61820-6917, USA.
SO: Western-corn-rootworm:-ecology-and-management. 2005; 121-144
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: This chapter discusses topics on Western corn rootworm (WCR), Diabrotica virgifera virgifera, biology and history, resistance to crop rotation (in maize and soyabean fields), WCR movement, movement and the WCR life cycle, factors influencing movement, measuring movement, diet and movement, and diet and mechanisms of rotation resistance..

Western corn rootworm: ecology and management.
ED: Vidal,-S; Kuhlmann,-U; Edwards,-C-R
AD: Institute for Plant Pathology and Plant Protection, Entomological Section, Georg-August University, Grisebachstrasse 6, 37077 Gottingen, Germany.
SO: Western-corn-rootworm:-ecology-and-management. 2005; xiv + 310
PB: Wallingford, UK: CAB International.
PY: 2005
LA: English
AB: This book provides a comprehensive review of the current knowledge of Western corn rootworm, Diabrotica virgifera virgifera, and how it might be managed both in North America and in Europe. Comparisons are drawn between plant protection techniques currently applied in North America and their potential application in Europe. Cultural, biotechnical and biological control measures are also addressed, as are ecological baseline data, i.e. population dynamics of the pest in North America and Europe, economic thresholds and aspects of its behaviour.