Biology, behavior, and genetic diversity of Trichogramma aurosum Sugonjaev & Sorokina

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Egg Parasitoid News

Previously "*Trichogramma* News"

No. 13 ISSN 1437-1413 December 2001

"Egg Parasitoid News" is a publication of the IOBC Working Group "Egg Parasitoids".

It aims to promote communication between researchers worldwide that are working on egg parasitoids. "Egg Parasitoid News" is published about once a year.

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Trichogramma News	No. 1	1983
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Editors:
O. Zimmermann, S.A. Hassan, A. Herz
Institute for Biological Control, Federal Biological Research Centre for Agriculture and Forestry, Heinrichstr. 243, D-64287 Darmstadt, Germany.
Fax +49 6151 407290, E-Mail: s.hassan.biocontrol.bba@t-online.de.

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(all information is listed by alphabetical order ot the authors)

See attached **Questionnaire for issue No. 14** of the "Egg Parasitoid News"

Find the online-version of this issue under website:
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News on the Working Group ”Egg Parasitoids"

International Organization for Biological Control

6th International Symposium

15-18 SEPTEMBER 2002 in Perugia, Italy

The next Symposium of the Working Group is planned for 2002 an will be held in Perugia, Italy. Pre-registration passed in 2001. Final registration and abstracts have to be submitted until 31 March 2002.

Sessions will traditionally cover basic and applied aspects, but proposals for innovative ideas, emphasising diversity in this group of parasitoids that exploit the same host stage, would be highly appreciated. This should lead to an integration of concepts and strategies, allowing to fully utilise not only the potential of *Trichogramma* but also that of other egg parasitoids, the beneficial role of which has so far been underestimated.

For more information please contact Dr. F. Bin. Further information can be found in the website: http://www.unipg.it/eggpar

Internet-links and information on meetings

A **symposium on egg parasitoids** will be held at the 5th International Society of Hymenopterists' meeting in Beijing, China, 22-26 July, 2002.
Organizers of this section are Dr. John Huber and Dr. Nai-Quan Lin.
About nine talks on egg parasitoids are expected, contributions are still welcomed.
Deadline for registration is 1 May, 2002.

website: whttp://www.ioz.ac.cn/zcd

contact and further information:
Dr. John Huber, ECORC,
K.W. Neatby Building,C.E.F., Ottawa, ON, Canada K1A 0C6
tel.: 613 759 -1840, fax: 613 759 -1927
e-mail: huberjh@em.agr.ca

There is **new periodical bulletin** with notes on *Trichogramma* and online-help for identification of Latin American species. It is planned to present information in *.pdf-files that can be be downloaded. You are welcomed to make contributions to this bulletin.

website: http://cnia.inta.gov.ar/trichogramma (former address: www.biocontrol.8m.net)

contact and further information:
Dr. Eduardo N. Botto, Insectario Investigaciones Lucha Biológica. (IILB)
IMYZA, CNIA-INTA, Castelar, (1712) Bs.As. Argentina
tel./fax.: 54 11 44814320 ext.26
e-mail: enbotto@hotmail.com, bottoen@arnet.com.ar

"Pest Directory" is a new worldwide database containing addresses of scientists and experts as well as essential information on agricultural pests and natural enemies including egg parasitoids. Aim of this non-profit organization is to promote information exchange in the field of pest management. "Pest Directory" is available on CD-Rom by ISPI – International Society for Pest Information. Contributing members are welcomed.

website: http://www.pestinfo.org

contact and further information:
Dr. Bernhard Zelasny & Olaf Zimmermann, c/o BBA Institute for Biological Control,
Heinrichstr. 243, D-64287 Darmstadt, Germany
e-mail: ispi@pestinfo.org

News in 30 words

Almatni, W.M., (Syria)
Trichogramma principium is released on about 800 ha / a against American bollworm in cotton in Syria. *T. cacoeciae* was released for the first time against codling moth last year.

El-Heneidy, A.H. (Egypt)
Trichogramma evanescens, a native species, has been used successfully in Egypt against the sugar-cane borer, *Chilo agammenon* in sugar cane fields and date palm pests, mostly *Ephestia* spp. .

Fursov, V. (Ukraine)
We are looking for egg- and larval parasitoids of stored products pests, including *Anisopteromalus, Lariophagus, Bracon* and *Venturia* and various Coleoptera and Lepidoptera. Cooperation with colleagues and collaborative projects are welcomed.

Hassan, S.A., Prozell, S. & Schöller, M. (Germany)
For a taxonomic study of the *Trichogramma evanescens* species-group, we are still looking for specimens from Turkestan and Central Asia, preferably living individuals.

Herz, A. & S.A. Hassan (Germany, Egypt, Tunesia, Greece)
A European project to control lepidopterous pests in olive started in 2002. The aim is to develop an IPM strategy with *Trichogramma* spp. and a pheromone confusion method. As we are baiting parasitoids of the olive borer *Prays oleae* and jasmin moth *Palpita unionalis* we are looking for suitable parasitoids from colleagues in mediterranean countries.

Monje, J.C., N. Haider & K. Schrameyer (Germany)
From August to September 2001 we found a *Trichogramma* species on eggs of *Noctua pronuba* on asparagus. It can be placed among the *exiguum*-section (*sensu* Pinto). Further morphological and molecular characterization is underway.

Pelletier, D. & G. Boivin (Canada)
Following lab trials, the suitability of two promising *Trichogramma* strains against the Cranberry Fruitworm (*Acrobasis vaccinii*) are beeing evaluated in commercial field conditions.

Ram, Pala & S.S.Sharma (India)
Egg parasitoid *Trichogramma chilonis* Ishii was recorded from the eggs of a sphingid moth, *Acherontia styx* Westwood on sesame in Hisar, Haryana, India. Rearing of collected sphingid moth eggs in 2001 revealed 76 per cent parasitisation by *T. chilonis.* Planting sesame near cotton plants enhanced parasitisation of *Helicoverpa armigera* eggs on cotton by 33 per cent.

Virla, E. (Argentina)
Since 1990, studies on the natural enemies of Auchenorrhyncha have been conducted. A survey of egg parasitoids against those economically important species as disease vectors is carrying on. The potential of these eggs parasitoids of leaf and planthoppers (Homoptera) is great. More studies will surely lead to using these species in biological control.

Practical use of egg parasitoids: Problems and suggestions

Almatni, W.M. (Sweida, Syria)
Trichogramma is released against cotton pests in small plastic containers (bird-egg shaped) which are left in fields after use. This strategy is applied since eight years in northern Syria. It caused severs earth pollution year after year. I need practical field experiences related to inundative release and to develop better release containers, which should be environment friendly and can stand high summer temperatures.

El-Heneidy, A.H., (Giza, Egypt)
Most of the problems associated with the practical use of Egg Parasitoids come from:The wide and misuse of insecticides, particularly in some economic crops such as cotton.In some developing countries, IPM programs still have not enough room for Biological Control agents.

Kabiri, Firouz (Valbonne, France)
We at BIOTOP are using two species of *Trichogramma* commercially: *T. brassicae* against the European Corn Borer on corn and *T. evanescens* against noctuid pests in greenhouses. On corn crop the efficacy is quiet good with about 80% parasitization and *Trichogramma* application can replace chemical treatment. In greenhouses the parasitization is at the same level, but the control of the pests is not satistactory. The farmers must use other beneficials or Bt and chemicals to complete *Trichogramma* efficacy. So the difficulty is to find methods which technically and economically suitable could be used in combination with *Trichogramma* applications.

Usha Rani, P. (Hyderabad, India)
Problems associated with practical use of egg parasitoids in India are:
1. Lack of awareness of the farmers about the benefits of parasitoids
2. Difficult application of parasitoids (diversity of farming systems and small cropping areas)
3. Lack of research in the use of egg parasitoids, lack of support from the government
4. Farmers rely on pesticides as they seem to give immediate protection;
   pesticides also can be stored for a longer time

Abstracts on current research work

Biosystematics, Genetics

Two new European species of *Trichogramma* (Hym.: Trichogrammatidae)
Pintureau, B., C. Stefanescu & M. Kenis (Villeurbanne, FRANCE; Sant Pere de Vilamajor, SPAIN; Delemont, SWITZERLAND)

Two new *Trichogramma* species from Europe are described. One of these species, *T. gicai* sp. nov., was collected in Northeast Spain from eggs of *Iphiclides podalirius* (Lep.: Papilionidae). It belongs to the *perkinsi* group and shows a long ovipositor. The other species, *T. acantholydae* sp. nov., was collected in Northwest Italy from eggs of *Acantholyda* spp. (Hym.: Pamphiliidae). It belongs to the *fasciatum* group and has the particularity of being univoltine with an obligatory diapause.

Ecology, Behaviour

A *Trichogramma* species harmless for *Chrysoperla carnea* in Syria
Babi, A. & B. Pintureau (Aleppo, SYRIA, Villeurbanne, FRANCE)

Trichogramma principium, a species released in Syrian fields to control three species of cotton bollworms, does not parasitize the eggs of the predator *Chrysoperla carnea* in nature. Such a parasitism occurs only in the laboratory when no choice exists for the hosts. In Syria, as well as in other countries, *C. carnea* eggs are parasitized by a *Telenomus* species at variable rates.

Behavioural ecology and functional morphology of egg parasitoids (Hym.: Scelionidae, Mymaridae) of pentatomid bugs, mirid bugs and noctuid stemborers
Bin, F., E. Conti, N. Isidoro, R. Romani., G. Salerno (Perugia, ITALY)

Objectives of our current research work are:
- behavioural ecology of *Trissolcus simoni*, *T. brochymenae* and *T. basalis* towards their co-evolved hosts (pentatomid bugs) on different host plants
- evaluation of host specificity through laboratory tests of possible host shifts, in terms of host location, recognition and suitability
- evaluation of old *vs*. new associations through literature databases combined with laboratory tests (pentatomid bugs)
- foraging strategies and morphofunctional adaptations of parasitoid species attacking concealed eggs (*Telenomus busseolae vs. Sesamia nonagrioides*) and embedded eggs (different species *vs*. mirid bugs)
- definition of the host unit as the complex of the characters of the host itself, the plant and the associated material and/or organisms exploitable by parasitoids (Conti, Salerno, Bin)

- functional morphology of antennal sensilla and glands in relation to sex recognition and host recognition (Isidoro, Romani, Bin)

Patch residence time in egg parasitoids: is innate estimate of patch quality always the best strategy?

Boivin, Guy and Eric Wajnberg (Quebec, CANADA; Antibes, FRANCE)

The Marginal Value Theorem predicts that female parasitoids should exploit host patches until their instantaneous rate of gain reaches a marginal value. Patch residence time was measured in an egg parasitoid, *Anaphes victus* (Hymenoptera: Mymaridae), when patch quality and travel time varied. The females stayed longer and exploited the patch to a higher level when patch quality and travel time increased. However, the marginal value at which females left the patch decreased with these parameters. Contrarily to *Trichogramma* species, *Anaphes* females appear to base their patch quality estimate on the first patch encountered rather than on a fixed innate estimate. Such strategy may be optimal when inter-generation variability in patch quality is high.

Studies on the biodiversity of East and West Palaearctic species of Trichogrammatidae

Fursov, Victor (Kiev, UKRAINE)

The taxonomical study of East and West Palaearctic species of *Trichogramma* and other Trichogrammatidae is being continued. New data on the biodiversity of *Trichogramma* and other egg-parasitoids depends on studies of the biology of various hosts (Lepidoptera, Coleoptera, Diptera and others). Therefor a programme of survey and collecting of native *Trichogramma* species in various parts of the Ukraine (North, South, East, Center regions) is in progress. Several stored products pests such as *Sitotroga, Ephestia* and *Plodia* (hosts for *Trichogramma*) and *Callosobruchus* and *Acanthoscelides* (hosts for *Uscana* egg-parasitoids) are being reared in laboratory cultures. Field studies of the biodiversity of *Trichogramma* and *Uscana* are also in progress.

Mechanisms regulating the interspecific competition of two sympatrically occurring species of *Trichogramma*

Haider, N.; J.C. Monje & C.P.W. Zebitz (Stuttgart- Hohenheim, GERMANY)

Trichogramma evanescens Westwood (sensu Pintureau) and *T. cacoeciae* Marchal (sensu Pinto) occur sympatrically in fruit orchards and vineyards in temperate regions. The hosts are *Cydia pomonella* L. in fruit orchards and both *Eupoecilia ambiguella* Hb. and *Lobesia botrana* Schiff. in vineyards. *T. cacoeciae* appears to be dominant under natural conditions and hence, this species might be more suitable for attempts at controlling these insect pests. However, the mechanism that regulates the populations of both *T. evanescens* and *T. cacoeciae* is unknown. Former work was aimed at assessing behavioral parameters of both *Trichogramma* species that might explain why *T. cacoeciae* has an apparent advantage over *T. evanescens*. Furthermore, preliminary work was done on interspecific competition relationships. During the present project it could experimentally be shown that *T. cacoeciae* can gradually replace *T. evanescens* when host availability is not limited. Further work is aimed at clarifying the competition relationships when the number of hosts is limited, which is the case under natural conditions. It is hypothesized that interspecific competition within

the host egg might be the key factor responsible for the observed differences in species composition.

Occurrence and distribution of *Trichogramma* spp. in vineyards
Ibrahim, R. & H. Holst (Geisenheim, GERMANY)

An evaluation of the occurrence of *Trichogramma* spp. in five different vineyards was conducted in Geisenheim, Rheingau (Hessia, Germany). A new device containing *Sitotroga cerealella* eggs for monitoring *Trichogramma* species was used. The results show that from end of april until middle of september *Trichogramma* could be found in vineyards surrounded by hedges, house gardens or orchards. Baiting just in monoculture vineyard areas could not detect *Trichogramma* . Best results in baiting parasitiods had been made in a vineyard within a variety of hedges (blackberry, elderberry a.o.) and cherry trees. Here *Trichogramma* occured in the vineyard and as well in the hedges. Until middle of july there was a pause in activity. At this period, the flight of the second generation of tortricid vine pests (*Lobesia botrana*, *Eupoecilia ambiguella*), *Trichogramma* occurred more often in the vineyard than in the hedges. From august until the end of the season the parasitoids could only be found in hedges. This suggests that the overwintering of *Trichogramma* is taking place in the hedges area surrounding the vineyards.
Species that could be found by baiting were *T. cacoeciae* that occurred more often and *T. evanescens*. Details of the results show that the activity of *Trichogramma* was highest at 80-120 cm and perferably on the underside of the leaves. In the vineyard there was a gradient of the parasitoids acitivity being higher the closer they were to the hedges.

Spatial density dependent egg parasitism of *Delphacodes kuscheli* (Homoptera: Delphacidae) by *Anagrus flaveolus* (Hymenoptera: Mymaridae) in Tucumán province, Argentina
Liljesthröm, G.G. & E. Virla (Cepave - La Plata, Tucumán, ARGENTINA)

Females of *Delphacodes kuscheli* Fennah, the only demonstrated vector of the Mal de Río Cuarto Virus (MRCV) that affects maize in Argentina, oviposit eggs in clusters beneath the epidermis of oat plants (among other hosts); usually a number of clusters can be found in the same plant as well as in neighboring plants. *Anagrus flaveolus* Waterhouse is an indigenous parasitoid that attacks eggs of *D. kuscheli* during the first days of development. We analyzed parasitism of *D. kuscheli* eggs by this parasitoid for spatial density dependence in Tucumán Province (Argentina). It was found that parasitism was direct density dependent. At the individual plant scale, and when only "homogeneous" (similar egg density) plants were considered, parasitism also increased significantly. When all individual plants were considered, parasitism was density independent, because plants with low, moderate or high egg density could be found in almost all groups. These results suggest that a patch (constituted by a small number of plants) could be recognized by the parasitoids, and that more parasitoids and/or more time were spent by each individual parasitoid in the more dense patches. More studies will surely lead to this species being used for control of economic plant and leafhopper species.

Competition between egg and larval-attacking parasites of tephritid fruit flies in Hawaii
Messing, R. & X. Wang, (Kapaa, Hawaii, USA)

Fopius arisanus (Sonan) and *Diachasmimorpha tryoni* (Cameron) are egg-larval and larval solitary endoparasitoids attacking the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), in Hawaii. This study investigated the outcomes of intrinsic competition between these two parasitoids, as well as characteristics of intraspecific competition within each species. Parasitization by *F. arisanus* resulted in direct mortality of host eggs and prolonged development of host eggs or larvae. Superparasitism by *F. arisanus* was uncommon when mean parasitism per host patch was <50%, but increased with rising parasitism. Superparasitism by *D. tryoni* was more common. In superparasitized hosts, supernumerary individuals of *F. arisanus* were killed as eggs (75%) or first instar larvae (25%) through physiological suppression, while supernumerary larvae of *D. tryoni* were killed mainly through physical combat. In multiparasitized hosts, 81.6% of *D. tryoni* eggs in the presence of *F. arisanus* larvae died within three days, indicating physiological inhibition of egg hatch. Only 2.1% of *F. arisanus* larvae died in the presence of *D. tryoni* larvae. The ratio of *D. tryoni* stings to ovipositions was higher in hosts not previously parasitized by *F. arisanus* than in parasitized hosts, suggesting that *D. tryoni* can discriminate against parasitized hosts.

Occurrence of *Trichogramma* species in Haryana
Ram, Pala & S.S.Sharma (Haryana, INDIA)

We collected the eggs of three lepidopterous insects sphingid moth, *Acherontia styx* Westwood on sesame; pierid butterfly, *Catopsilia pyranthe* on *Cassia* sp. and *Helicoverpa armigera* on cotton in Hisar and adjoining areas from July to September, 2001. Rearing of these eggs under laboratory conditions revealed that 76 per cent eggs of *A. styx* were parasitised by *T. chilonis.* On an average 20 adults of *T. chilonis* emerged from a parasitised egg of *A. styx*. In case of *C. pyranthe* average egg parasitism by *Trichogramma* sp. was 84 per cent. Collection and rearing of *H. armigera* eggs from cotton plants planted near sesame rows showed 33 per cent parasitisation by *T. chilonis.* No egg parasitism of *H. armigera* was recorded in a nearby cotton field without sesame rows. Both the fields were frequently sprayed with insecticides by the farmers to control bollworms. Intercropping sesame in cotton may help in enhancing parasitisation of *H. armigera* eggs by *T. chilonis.*

Biology, behavior, and genetic diversity of *Trichogramma aurosum* Sugonjaev & Sorokina
Samara, R.; J.C. Monje & C.P.W. Zebitz (Stuttgart- Hohenheim, GERMANY)

Trichogramma aurosum Sugonjaev & Sorokina has been collected from several hosts, including eggs of *Nematus* spp. (Hymenoptera: Tenthredinidae), noctuids and also from a major insect pest of fruit orchards, *Cydia pomonella* (L.). However, nothing is known about the biology and behavior of this species. Since *T. aurosum* might be a potential candidate for attempts at controlling *C. pomonella*, research work has been started to assess its biology and behavior towards eggs of this pest. As a first step, *T. aurosum* was collected in several locations in Germany. Studies on genetic diversity as well a molecular comparison with morphologically close related species have been started. Secondly, an appropriate factitious host has been found to reproduce *T. aurosum* in quantities enough for mass release. Contrary to most *Trichogramma* species, females of *T. aurosum* do not accept eggs of *Sitotroga*

cerealella for parasitization, while this is not the case with eggs of *Ephestia kuehniella*. Populations of different geographic origin will be tested towards their parasitization capacity, fecundity, longevity, host age and host preference in order to obtain suitable strains for potential use in biological control. Furthermore, their adaptation to adverse biotic conditions will be assessed in form of life-table studies. As *T. aurosum* is of holarctic nature, the degree of conspecifity with North American populations might provide useful information for phylogenetic studies. For this, cooperation work with the University of California-Riverside is focussed.

Biology, Physiology

Role of Volatile Infochemicals in Host Orientation and Host Habitat Location of Parasitoid *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae)

Bai, Shu-xiong, Wang, Zhen-ying, He, Kang-lai, Zhou Da-rong, (Beijing, CHINA; Dae-joon, KOREA)

Olfactory response of an egg parasitoid wasp, *Trichogramma ostriniae*, to the volatiles from 14 varieties of mungbean (*Vigna radiata*), sweet corn, moths and eggs of the host insect, Asian corn borer (ACB), *Ostrinia furnacalis* (Guenée), were studied in laboratory. Active bioassays of the components from volatiles of mungbeans and egg masses of ACB to *T. ostriniae* females were carried out in laboratory. Mechanisms of attraction and augmentation function of some creeping type mungbean for *T. ostriniae* were discussed. The results are as follows:

Volatiles emitted from different parts of mungbean and corn plants were extracted by a self-designed device. Olfactory responses of *T. ostriniae* to the volatiles were measured by a four-armed olfactometer. Results indicated that *T. ostriniae* was attracted to the most of creeping type mungbean plants volatiles, such as Do660, Do686, Do658. Higher attraction was observed in volatiles from whole plants and leaves of some creeping type mungbean. None tested erecting type mungbean plants volatiles could elicit any response. *T. ostriniae* females did not show any response to the volatiles from flowers of tested creeping and erecting type mungbeans. The female wasps only showed lightly response to the volatiles of young tassels, but no response to leaves and silks from sweet corn.

Olfactory response of *T. ostriniae* to volatiles emanating from the different stages of ACB adults, their accessory gland and eggs were measured. It have been demonstrated that airborne chemicals from egg masses, (E)-12-tetradecenyl acetate (E12-14:Ac) (main individual component of ACB sex pheromone), mated-female moths before their first oviposition and their accessory glands stimulated an intensive search behavior by *T. ostriniae* females, on the other hand, volatiles from virgin or females tested after their first oviposition and their accessory glands did not incite the parasitoid's movement.

Host-feeding and synovigeny in *Trichogramma* spp.

Boivin, Guy (Quebec, CANADA)

The Trichogrammatidae are generally described as a homogeneous group of egg parasitoids that are short-lived, pro-ovigenic and with diverse responses to temperature that are shaped by host and habitat. When fecundity and temperature responses (survival, parasitism) were

measured in host presence on 40 species and strains of *Trichogramma*, thelytokous species were homogenous in having a short longevity and performing better at lower temperature. Arrhenotokous species were less homogeneous. Species with short longevity (<72h) had a response similar to the thelytokous species while species that lived longer (>72h) had a higher optimal temperature. The hypothesis that longer survival in some arrhenotokous species was due to host-feeding was verified using two species per group (thelytokous, short-lived arrhenotokous and long-lived arrhenotokous). Results indicate that host-feeding occurred only in long-lived species and explained their higher longevity. When deprived of food and host, all species were short-lived. Species that host fed also produced eggs throughout their life, indicating that they are synovigenic. *Wolbachia*-induced thelytoky may occur more readily in species with low optimum temperature because species with higher optimum may be cured more often when exposed to high temperature. However, it remains unclear why *Trichogramma* genus seems to be divided into host-feeding, synovigenic species with high temperature optimum and non-host-feeding, pro-ovigenic species with lower optimum temperature.

Egg management patterns of *Trichogramma dendrolimi* and *Trichogramma cacoeciae* under host deprivation.

Hegazi, E. M. & W. E. Khafagi (Alexandria, EGYPT)

In cooperation with Dr. S. Hassan , Institute for Biological Control, Darmstadt, Germany, the effect of temporary host deprivation on parasitism rates of *Trichogramma cacoeciae* March. and *Trichogramma dendrolimi* Mats was studied (Biocontrol Science and Technology 11 (2001), 353-359). The production and management of eggs by the two species revealed to be completely different. The data suggest that *T. dendrolimi* is a typical proovigenic species, whereas *T. cacoeciae* is neither definitely proovigenic nor synovigenic. Concerning the use of these species in biological control, the efficiency of *T. dendrolimi* - females may be more sensitive to host deprivation than *T. cacoeciae.*
In an ongoing study, further biological and ecological traits of *T. cacoeciae*, when reared on a non-habitual host (*Spodoptera littoralis*) will be evaluated.

Multiple mating in males and females Trichogramma evanescens (Westwood) (Hymenoptera: Trichogrammatidae)

Jacob, Sebastien & Guy Boivin (Quebec, CANADA)

For the majority of parasitoid species, females are monoandrous and mate only once during their lifetime while males are polygynous (Baker et al. 1998). However, in some parasitoid species, females mate several times and are then qualified as polyandrous (van den Assem and Bruijn 1977, van den Assem 1986). We determined if the females of the egg parasitoid Trichogramma evanescens are monoandrous or polyandrous and if males are able to produce spermatozoids throughout their lifetime. Furthermore, we wanted to quantify how many females one male can fertilize over his lifetime as well as the quantity of sperm transferred per copulation.
In this study, we tested two major hypothesis: 1) T. evanescens males are prospermatogenic and 2) T. evanescens females are polyandrous and mate several times during their lifetime. Male spermatogenesis was established by verifying the number of females a male can fertilized per day and the progeny produced by these females. Secondly, the polygamy of females has been investigated by measuring both daily fecundity and sex ratio of females mated once or several times. We have demonstrated that males are polygynous and

prospermatogenic. They mate up to 20 females during their lifetime, among which 80% are mated in the first 24 hours. Their lifetime fertility is estimated between 300 and 600 spermatozoids. Females are polyandrous in spite of the fact that no difference was found in the sex ratio and the fecundity between multiple mated and simple mated females.
Polygyny and prospermatogeny limit the quantity of spermatozoids that males can transfer to females. Nevertheless, at the first mating with a virgin male, a virgin female receives enough spermatozoids to produce an optimal sex and progeny allocation. But why are the females doing multiple mating if there are no apparent advantages? We suggest four explanations why polyandry should be advantageous. First, the cost for a mated female to simply accept the other males might be lower than those involved in repulsing them. Secondly, the polyandry might be an adaptative strategy to minimize the cost of mating with a male who has already emptied his sperm bank by mating several females. If females are unable to perform sexual selection, polyandry might increase their chances to mate with a virgin male with a full sperm bank, or enable them to accumulate enough spermatozoids from different males. Thirdly, the polyandry might also be adaptive by increasing genetic variability in the population. Finally, multiple mating by female T. evanescens could be an advantageous strategy to accumulate energy resources if males transfer a nuptial gift during mating.

Introduction of *Enoggera reticulata* as a possible biological control agent for the Eucalyptus tortoise beetle, *Trachymela sloanei*

Millar, Jocelyn G., Timothy D. Paine & Kathleen Campbell (Riverside, USA)

The Eucalyptus tortoise beetle, Trachymela sloanei (Coleoptera: Cerambycidae) was recently introduced into California, where it has caused considerable damage as a defoliator. Efforts are underway to establish the egg parasitoid Enoggera reticulata, obtained from collaborators in South Africa, as a biological control agent for this new pest species.

Addition of *wsp* sequences to the *Wolbachia* phylogenetic tree and stability of the classification

Pintureau,B., S. Chaudier, F. Lassablière, H. Charles & S. Grenier (Villeurbanne, FRANCE)

Wolbachia are symbiotic bacteria altering reproductive characters of numerous arthropods. Their most recent phylogeny and classification are based on sequences of the *wsp* gene. We sequenced *wsp* gene from six *Wolbachia* strains infecting six *Trichogramma* species that live as egg parasitoids on many insects. This allows to test the effect of the addition of sequences on the *Wolbachia* phylogeny, and to check the classification of *Wolbachia* infecting *Trichogramma*. The six *Wolbachia* studied are classified in the B supergroup. They confirm the monophyletic structure of the B *Wolbachia* in *Trichogramma*, but introduce small differences in the *Wolbachia* classification. Modifications include the definition of a new group, Sem, for *Wolbachia* of *T. semblidis*, and the merging of the two closely related groups Sib and Kay. Specific primers were determined and tested for the Sem group.

Effect of cold storage on the biological quality of Trichogramma nerudai (Hymenoptera: Trichogrammatidae)

Tezze, A. A. & E. N. Botto (Buenos Aires, ARGENTINA)

The recently discovered species *Trichogramma nerudai* Pintureau and Gerding (Hymenoptera: Trichogrammatidae), could be used in biological control programs of forest and agricultural insect pests. The possibility of storing *T. nerudai* at low temperature and the effects of such storage on the biological quality of the parasitoid and its progeny were studied. *T. nerudai* pupae were stored 25, 50, 75, 100, 125 and 150 days at 4° ± 1° C in a refrigerator, RH = 75 ± 5 % and full darkness. *T. nerudai* pupae were tolerant to cold storage. Important components of the biological quality in Trichogramma as the number of emerged adults, the proportion of deformed adults, and the flight and the mobility capacity were not seriously affected untill 50 days of cold storage. However, the biological quality of the parasitoids was significantly affected by cold storage from 75 days onwards. Any effect was found on the progeny of the parasitoids. We conclude that cold storage is useful to store T. nerudai pupae up to 50 days.

Endogenous variations in photoperiodic influence on the progeny diapause in *Trichogramma embryophagum*

Reznik, S.Ya., T.S.Kats,T.Ya.Umarova & N.D.Voinovich, (St.Petersburg, RUSSIA)

A laboratory study was carried out with the isofemale parthenogenetic strain of *Trichogramma embryophagum* Htg. Experiments revealed long-day type response based on maternal influence on progeny prepupal diapause. Comparative analysis of photoperiodic responses in successive laboratory generations reared under constant conditions revealed significant fluctuations in the tendency to diapause. The maximum rate of progeny diapause was recorded at day length of 12 and 15 h, the estimated threshold photophase ranged from 6 to 10 h (left threshold) and from 16 to 17 h (right threshold). Thus, the left threshold day-length was very variable, while the right threshold day-length kept relative constancy (the possible reason is that the right threshold is subjected to stabilizing selection in the natural conditions, while the left threshold zone is a selectively neutral character revealed only in laboratory experiments). Experiments with individual females sequentially offered with new portion of host eggs demonstrated that the percentage of prepupal diapause was maximal in the progeny eclosed from the eggs laid during 1st - 2nd days of maternal life. Then the proportion of diapausing progeny decreased and then slightly increased in 14 - 18 days old females. We conclude that endogenous factors (maternal age and variation in generation sequence) play an important role in maternal influence on progeny diapause, particularly in the neighborhood of threshold temperature and photoperiodic conditions.

Diapause induction and cold storage in *Trichogramma nerudai* Pintureau and Gerding (Hymenoptera: Trichogrammatidae) pupae

Tezze, A. A. & E. N. Botto (Buenos Aires, ARGENTINA)

Diapause induction in egg parasitoids can be used as a storage technique. The effect of different cold storage periods on previously diapause induced *Trichogramma nerudai* pupae was evaluated on the parasitoid and its progeny.
Diapause induction and breaking were obtained following the methodology developed in the Soviet Union for *T. evanescens* and *T. pintoi*. The experimental sequence followed in the treatments was: diapause induction – cold storage – diapause breaking – standard conditions.

Cold storage times were 60, 120 and 150 days (treatments). Non diapause induced pupae (control group) and emerged adults after breaking the diapause were maintained at rearing standard conditions (temperature: 25 ° C; humidity: 80 ± 5 %; photoperiod: L14:D10).
The female survival at 24 h, the proportion of deformed adults, the females proportion and the flight and the mobility capacity were not seriously affected by this storage method. The number of emerged adults decreased in the 120 and 150 days treatments untill 60 %, which is a quite acceptable value in a mass rearing program.
The diapause induction admitted to cold store *T. nerudai* without altering the biological quality of the parasitoid and its progeny. This storage method allows a storage period three times greater than a simple cold storage technic but requires about a month for the diapause induction. Depending on the time the pupae must to be stored, one or the other method could be used.

Ovipositional and orientation responses of two species of *Trichogramma* towards the chemicals from the rice (*Oryzae sativa*) plants as well as two major pests of rice
Usha Rani,P (Hyderabad, INDIA)

Ovipositional preferences and orientation responses of two species of *Trichogramma*, *T. japonicum* and *T. chilonis*, towards the materials extracted from their host insects, Rice yellow stem borer, *Scripophaga incertulas* walker. (*Tryporyza incertulas*), Lepidoptera: Pyralidae, rice leaf folder: *Cnaphalocrosis medinalis* (Guenee) (Lepidoptera : Pyraustidae) were evaluated in the laboratory, semi field and field. Role of plant surface chemicals from the pest damaged and undamaged plants was determined. The active chemicals were isolated and identified using GC - Mass analysis. The orientation response of the parasitoid were carried out in olfactometer tests, while the success of parasitization was recorded in petri dish bioassays. Scanning Electron Microscopic studies were conducted to identify various sensillary population on the antennae of *T. chilonis* and *T. japonicum* and the morphology is compared between the two species of parasitoids.

Selection of species for use in biocontrol

Host preference of various strains of *Trichogramma cacoeciae* Marchal towards eggs of codling moth *Cydia pomonella* L. and grape berry moth *Lobesia botrana*
Almatni, W.; J.C. Monje & C.P.W. Zebitz (Stuttgart- Hohenheim, GERMANY)

The host preference behavior of four strains of *Trichogramma cacoeciae* Marchal (*sensu* Pinto, 2 from Sweida-Syria, 1 from Denmark and 1 from Germany), toward eggs of *Cydia pomonella* and *Lobesia botrana* was investigated in the laboratory in order to select candidate strain for inundative release against the codling moth in southern Syria. Experiments were carried out in two ways: (1) directly by continuous observation of the behavior of individual females and (2) by an indirect selection test. Test females were offered equal numbers of eggs of two host species arranged in grid. The Danish (Dan 99) and the German (Cac D90) strains strongly preferred *C. pomonella* over *L. botrana* eggs. Only a slight preference for *C. pomonella* eggs was found in the Syrian strains Syr1 and Syr2. The Syrian strain Syr2 showed no significant preference for either host. Percentage of parasitized eggs from the total provided eggs in the 1 hour observation experiments were 35.4%, 48.2%, 29.4%, and 29.6% for Syr1, Syr2, German and Danish strains, respectively. Rejections were found to be significantly concentrated directly after contact and during drumming in the Danish, the

German and the Syrian strain Syr1, whereas for the Syrian strain Syr2 rejections happened mostly during drilling and very few during drumming. The results suggest that the Syrian strain Syr2 is an suitable candiadte for attempts at controlling the codling moth in southern Syrian where apple orchards are naturally mixed with grapevine yards.

Effects of Gamma Radiation to Some Biological Properties of Mediterranean Flour Moth Ephestia kuehniella Zeller (Lepidoptera: Pyralidae) and Egg Parasitoid Trichogramma evanescens Westwood (Hymenoptera: Trichogrammatidae), PhD Thesis.
Ayvaz, A. (Kayser, TURKEY)

In this study we have tested the effectiveness of *Trichogramma evanescens* Westwood (Hymenoptera: Trichogrammatidae) to its factitious host *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae) under various conditions. Egg, larvae, pupae and adult stages of *E. kuehniella* were treated with gamma radiation doses between 50-550 Gy. Parameters such as fecundity, emergence, longevity and sex ratio were investigated. All experiments were undertaken in growth chamber and maintained at 27±05 ºC, 70±5% r.h and 14:10 (L:D) h for *E. kuehniella* and 24±05 ºC, the same relative humidity and photoperiod for *T. evanescens* . Data showed that emergence, fecundity and longevity were decreased with increasing doses in all stages, and sex ratio shifted in favor of males. When the egg and larvae were treated with gamma radiation, all the adults obtained from these stages were sterile at 200 Gy and above doses. This value was 300 Gy for pupae and adult stages. Using probit analyses SD50, SD99 and LD50, LD99 values were estimated. Irradiated 1-day-old host eggs were parasitized more than control at 40, 60, 80, 100 and 300 Gy doses. For two-day-old eggs, the same results were obtained at 20 and 40 Gy. In host preference tests with treated and untreated eggs, they were equally preferred by *T. evanescens* , except 100 and 140 Gy doses. Irradiated host eggs with 100 Gy were less preferred than untreated eggs, but treated eggs with 140 Gy. In host preference tests with untreated eggs and eggs from irradiated adults, they were equally preferred, the same result were also obtained for treated eggs and eggs from treated adults. When *T. evanescens* were irradiated with gamma radiation, emergence, female ratio and parasitization were decreased with increasing doses, but there were no differences in F1 and F2 generations compared with control regarding these parameters. Our results obtained from host egg storage indicate that parasitization and adult emergence were gradually decreased in the course of time in treated eggs, but this tendency was more obvious in control.

Comparison between *Trichogramma evanescens* Westwood and *Trichogrammatoidea bactrae* Nagaraja as biological control agents against two irradiated and non-irradiated stored product pests
El-Mandarawy, Mona B.R. & Salwa A. Rizk (Dokki, Giza, EGYPT)

Studies on the effect of substerilizing doses of gamma radiation on the stored product insects *Callosobruchus maculatus* (Fabricius) and *Corcyra cephalonica* (Stainton) eggs before parasitization by *Trichogramma evanescens* Westwood and *Trichogrammatoidea bactrae* Nagaraja were carried out. *C. maculatus* and *C. cephalonica* eggs were exposed to the respect calculated LD25 level 92.48 Gray and 1.39 Gray as substerilizing doses. The percent of parasitization and fecundity differed significantly between the two parasitoids species and the two hosts. They were higher in *T. evanescens* than in *T. bactrae*. However, the percent of parasitization and fecundity were insignificantly differed between the irradiated host eggs as compared to the non-irradiated ones. Highest emergence rate was recorded from irradiated and non-irradiated *C. cephalonica* eggs that parasitized with *T. evanescens*. Radiation had no

effect on the developmental period (days) and adult longevity of the two parasitoids reared from the two hosts.

Possibilities for using *Trichogramma turkestanica* for biological control of the Mediterranean flour moth in industrial flour mills
Hansen, Lise Stengaard (Kgs. Lyngby, DENMARK)

Life table parameters and other aspects of the biology (host-feeding, lower threshold for activity) of Trichogramma turkestanica Meyer have been investigated in the laboratory in relation to temperatures of 15, 20, 25 and 30°C. Results can be seen in Hansen 2000 and Hansen & Jensen 2001 (see list of publications). A field trial has been conducted in an industrial flour mill in 2000.

Host specificity studies with *Avetianella longoi*, a parasitoid of *Phoracantha* spp. (Coleoptera: Cerambycidae)
Paine, Timothy, D., Jocelyn G. Millar, Darcy Reed (Riverside, USA)

Phoracantha semipunctata and *P. recurva* have been introduced into California, and many other areas of the world where Eucalyptus are grown. The egg parasitoid *Avetianella longoi* is an effective biological control agent for the former species, but attack rates and survival of parasitoids are lower on the congeneric species *P. recurva*. Behavioral and biochemical mechanisms that might account for these differences are being investigated.

Evaluation of North American species of *Trichogramma* Westwood (Hymenoptera: Trichogrammatidae) for control of the Indian meal moth, *Plodia interpunctella* (Hübner) (Lepidoptera: Pyralidae).
Schöller, Matthias & Paul Fields (Berlin, GERMANY, Winnipeg, CANADA)

Stored-product moths are among the major stored-product pests, infesting a wide variety of cereals and cereal based products. Traditional chemical control measures require the shut down of the facility, and there are restrictions to their use because of concerns of worker safety or residues on the finished product. In Germany and Austria, the control of the Indian meal moth *Plodia interpunctella* (Hübner) and the Mediterranean flour moth *Ephestia kuehniella* Zeller in food processing facilities is achieved by releasing large quantities of *Trichogramma evanescens* Westwood using the inundative strategy. In North America, despite the wide-spread use of parasitoids in field and glass house settings, this biological control method has not been used commercially to control warehouse and food processing moth pests.
We evaluated four species of *Trichogramma* native to North America: *T. deion*, *T. minutum* (2 strains), *T. pretiosum* (2 strains), *T. sibericum,* and the palaearctic introduction *T. brassicae* as candidates to control *P. interpunctella*. In a first step, we performed the indirect Hassan-test for host preference between the mass-rearing host *E. kuehniella* and the target host *P. interpunctella*, and the performance at 15°C. In these tests, a thelytokous strain of *T. pretiosum* performed the best, followed by an arrhenotokous strain of *T. pretiosum,* and *T. deion*, followed by a strain of *T. minutum. Trichogramma brassicae*, another strain of *T. minutum* and *T. sibericum* had the lowest acceptance of *P. interpunctella* eggs. In a second step, we determined the two species best suited to control *P. interpunctella* by applying the

direct Dijken-test for host preference and daily fecundity on *P. interpunctella*. Additional tests will be conducted with these two species in semi-commercial and commercial settings.

Selection of *Trichogramma* spp. against the Common Clothes Moth *Tineola bisselliella*
Zimmermann, O., S.A. Hassan & Wührer, B. (Darmstadt, GERMANY)

In laboratory experiments suitable *Trichogramma* spp. were selected to control tineid moths. Acceptance and preference tests found *T. piceum* to be the most efficient among 30 species and strains that are available in laboratory rearing. The searching behaviour on cloth with natural egg laying in tubes and cages showed that *Trichogramma* could find eggs in cloth up to distances of minimum 40 cm from releasing point. Still the big surface of different kinds of stored products containing keratin in wool is a limiting factor. The experimental study will be continued with conducting life table tests of the three most suitable species. In order to find an efficient egg parasitoid to combine with the larval parasitoid *Apanteles carpatus* (Braconidae) the results with *Trichogramma* spp. in laboratory underline the potential of a combined use of egg and larval parasitoids in stored products protection.

Mass production, artificial diet, nutrition

Corn pollen as a food source for *Trichogramma brassicae*
Zhang, G. R., O. Zimmermann & S. A. Hassan (Darmstadt, GERMANY)

Trichogramma brassicae Bezd. (Hymenoptera: Trichogrammatidae) females fed on corn pollen and water (wet filter paper dusted with pollen) were found to live longer (4.97d) than females fed on water alone (2.67 d), but significantly shorter than 8.23 d or 8.37 d for feeding on pollen and honey or honey alone, respectively. In the presence of host eggs (*Ostrinia nubilalis* Hübner), the longevity of the females fed on pollen and water was 4.90 d, which was also significantly longer than 2.60 d for water alone, but significantly shorter than 12.17 d or 12.33 d for pollen and honey or honey alone, respectively. The cumulative lifetime fecundity (pupae number of the offspring per female) was 82.53 when fed on pollen and water, which was significantly higher than 61.70 for no food (only water) but lower than 99.97 and 95.70 for feeding on pollen and honey or honey alone, respectively. As a food source, corn pollen also increased the net reproduction rate (R_0), intrinsic rate of increase (r_m), and finite rate of increase (λ), and reduced the doubling time (T_2, days), but had no effects on the emergence rate, sex ratio, and mean generation time (T_c). Feeding experiments with individual females proved that 13 out of 30 tested females notably consumed pollen grains and that the number of pollen grains ingested was quantitatively estimated to be 2.46 ± 0.40 per female in 48 h.

Utilization

First field release of *Trichogramma cacoeciae* Marchal (Trichogrammatidae, Hymenoptera) for the control of codling moth, *Cydia pomonella* at Sweida, southern Syria

Almatni, W. (Damascus, SYRIA) & J.C. Monje & C.P.W. Zebitz (Stuttgart- Hohenheim, GERMANY)

Trichogramma cacoeciae Marchal (*sensu* Pinto)was released for the first time in an attempt at controlling the codling moth *Cydia pomonella* in Syria during the year of 2001. The experiment was carried out in a young commercial apple orchard in Jabal Orman, Sweida. *T. cacoeciae* Marchal (strain Syr2) was released two times at a rate of 150-parasitoids / tree/ release. Efficacy was 34.37% reduction in fruit damage compared with untreated plots. This result showed that 2 applications at this rate on the second generation of *C. pomonella* were not efficient to prevent damage above the economic threshold.

Practical use of egg parasitoids in Turkey

Ayvaz, A. (Kayser, TURKEY)

The use of egg parasitoids as pest control agents in our country is not common yet. But some promising studies have been conducted currently. In Adana, also named Çukurova , there are some studies targeting this purpose. We are trying to improve the effectivenes of *Trichogramma evanescens* by using gamma radiation to enhance parasitoid quality, and present studies show that combining these two methods shall be effective for pest control. We are going to release *T. evanescens* experimentally in our laboratory. Following that we are going to implement the parasitoids on natural conditions.

Biological control using *Trichogramma* in Uruguay

Basso, C., B. Pintureau & G. Grille (Montevideo, URUGUAY)

Experimental inundative releases using *Trichogramma* wasps are performed in Uruguay against pest of economical importance in cotton (*Alabama argillacea* (Hubner), Lepidoptera: Noctuidae), Lotus (*Epinotia aporema* (Wals), Lepidoptera: Tortricidae) and apple (*Argyrotaenia sphaleropa* (Meyrick) and *Bonagota cranaodes* (Meyrick), Lepidoptera: Tortricidae). *Trichogramma* species are reared in the laboratory on *Ephestia kuehniella* Zeller eggs.

Trials to control the olive moth, *Prays oleae* (Bern.), with two *Trichogramma* species

Bento, A, Pereira, J.A., Torres, L.M & Torres, R. (Bragança, Trás-os-Montes e Alto Douro. PORTUGAL)

A study was carried out in north-eastern Portugal to establish whether inundative releases of *Trichogramma* were effective in reducing damage caused by *Prays oleae* (Bern). In 1997 and 1998 releases of *Trichogramma cacoeciae* March. alone and *T. cacoeciae* plus *T. dendrolimi* Mats, in equal numbers, were tested against the fruit generation of the pest, in an experimental olive grove, near Mirandela. Nine plots were established in the field, corresponding to one control and eight treatments (100 000, 200 000, 400 000 and 800 000 individuals of *T.*

cacoeciae and the same figures of *T. cacoeciae* plus *T. dendrolimi*, per hectare). Two releases were made at an interval of one week, in the olive moth ovipositional period. Rates of parasitism of eggs ranging from 46,9% and 28,4% have been achieved in the release trials, respectively in 1997 and 1998, following the release of 800 000 *T. cacoeciae* per hectare, while the parasitism obtained with the release of 400 000 *T. cacoeciae* plus 400 000 *T. cacoeciae*, ranged from 30,7% to 25,1%. The corresponding figures for the control were 2,2 % and 0,8 %, respectively in 1997 and 1998. The results suggest the potential of *T. cacoeciae* when used inundatively against the fruit generation of *P. oleae* in north-eastern Portugal. Further investigation is needed in the use of native strains of *Trichogramma* which may be better adapted to suppressing the pest in the summer high temperatures of the region.

Trichogramma exiguum and mechanical method to control tomato fruit borer *Neoleucinodes elegantalis* (Lepidoptera: Pyralidae)

Díaz, A. E. , J. de J. Peña, G.Silva & A. Tróchez (Corpoica C.I, Palmira, COLOMBIA)

Tomato fruit borer (Neoleucinodes elegantalis)is one of the major insect pests, causing yield losses of 80% or higher. Control practices by farmers rely exclusively on the intensive use of chemical pesticides, which have low efficiency but increase costs and damage the environment. An experiment was established in 1999 A by CORPOICA at the Palmira Research Center (Palmira, Valle del Cauca) to evaluate mechanical (low and high density, clear polyethylene bags) and biological (the egg parasitoid *Trichogramma exiguum*) methods as alternatives for control of the tomato fruit borer. Floral structures were covered with polyethylene bags where 50% of the flowers were opened. *T. exiguum* (at a weekly of 678.000 wasps/ha) was released by cardboard device hunged on the plants carrying 0.125 g. of *Sitotroga cerealella* eggs each. The eggs was parasitized at five different dates. Data were taken on parasitism by *T. exiguum* fruit damage, fruit set index, fruit weight, fruit size, color, soluble solids, juice content and acidity. Plots treated with *T. exiguum* revealed parasitism levels higher (49%) than the unprotected controls (29%). Egg population (density) and parasitism in unprotected control plots exhibited a negative correlation. Fruit damage by the tomato fruit borer was significantly lower ($p = 0.05$) in bagged plots (2.3%), compared to plots treated with *T. exiguum* (19.4%) or the unprotected controls (37.7%). Fruit set index, determined at harvest was higher in control plots (17%) compared to *T. exiguum* treated plots (13.6%) or bagged plots (13.26%). In addition, bagged fruits exhibited lower sugar content, lower color at maturity and increased acidity. Unbaged fruits had 17% more fruit juice, higher weight and size.

Experiments for the control of cotton bollworms in Egypt

El-Heneidy, A.H., Abdel-Hafez, Alia & Mesbah, A.H. (Giza, EGYPT)

Cotton bollworms; the pink bollworm, *Pectonophora gossypiella* (PBW) and the spiny bollworm, *Earias insulana* (SBW) are the major economic cotton pests in Egypt. Trials to evaluate using several *Trichogramma* species to control the two competitive pests were carried out during the cotton season 2001.
Four species of the egg parasitoids; *Trichogramma embryophagum*, *T. brassicae*, *T. evanescens* and *Trichogrammatoidae bactrae* have been tested against the two pests under field conditions at eastern Delta. This area is recognized by a low infestation of SBW. The four species were released three times in unsprayed cotton field (40 acres). All the species showed relative preference to the PBW eggs. Results showed an obvious reduction in the

PBW infestation, ranged between 56.5 and 81.7 %, compared with the control. *T. bactrae* was the most efficient among the tested species while *T. brassicae* was the least one.
A trial to control the two cotton pests, using only *Trichogramma evanescens* was carried out in northern Delta, where the SBW is very competitive. The control plot was sprayed with insecticides four times. Four releases of the parasitoid were used in the unsprayed cotton field (2 acres). Results showed 24 % reduction in the PBW infestation in the unsprayed plot compared with the sprayed one. On the contrary, SBW infestation in the unsprayed plot reached three folds that of the sprayed one, which means that the parasitoid is not effective against the pest.

Trials for the biological control of the pyralid *Ectomyelois ceratoniae* (Lepidoptera, Pyralidae) by the use of *Trichogramma cacoeciae* (Hymenoptera, Trichogrammatidae)
Jardak T., Ksantini M. & Njah A. (Sfax, TUNISIA)

The carob pyralid *Ectomyelois ceratoniae* is an important polyphagous pest which attacks several cultures in Tunisia (date palm, pomegranate fruit, almond, pistacia fruit, carob), causing serious damage, especially to date and pomegranate fruit. Particularly for this later culture, the important production losses caused by the pyralid (up to 80%) in the lack of effective control, induce growers to desert this cultivation. Since 1996, our attention was focused on the use of biological control by releases of *Trichogramma cacoeciae*, collected on the natural host eggs of the pyralid in an oasis. After promising results in a first trial in 1996 (Jardak and Ksantini, 1998) experiments were pursued during 2000. After rearing on *Ephestia kühniella*, *T. cacoeciae* has been released at the nymphal or adult stage on cardboard plates placed in the tree and protected from predation by small cages of wire mesh. Five treatments were tested : 3 doses of parasitoid eggs (3000, 6000 and 9000) placed in each tree, the dose of 27000 parasitoid eggs applied in the center (at one tree) of a plot of 9 trees (dose of 3000 parasitoids/tree) and the control plot. Releases were realised each week or every 12 days (in July and August) from april 22 to the harvesting period (end of september). Data on the fruit fall, fruit rotting and healthy fruit harvested without the presence of the insect were collected. The main results were the following :
1) the parasitism rate seems to be comparable between the three doses per tree: it varies between 67.4 %, 61.3 % and 66.4% , respectively , for 3000, 6000 and 9000 parasitoids / tree. The maximum rate varies from 86 to 100%
2) the parasitism rate obtained with one release point for 9 trees is comparable (69.4%) to that with 3000 parasitoïds in each tree. This result demonstrates the dispersion ability of the parasitoïd which can reach about 100 meters (high parasitism was observed in the control)
3) the harvested healthy fruit, suitable for consumption, represent an average of 45.2% of the total fruit, present in the treated plots at the end of August, while it was only 24.4% in the control plot though the case of the parasitoid dispersion

Biological Control with *Trichogramma*: make it reliable and easiest possible
Kabiri, Firouz (Valbonne, FRANCE)

Biotop started commercialization of *Trichogramma* against the European Corn Borer in 1985. The product was proposed with 3 releases to control one generation of the pest each year. Surfaces increased very slowly and reached about 20 000 ha of corn in 1996. Then the method was simplified and it became possible to make just one release with the same efficacy against the ECB. In 2001 about 70 000 ha were protected in France and other countries with our production. The keys of the success are: efficacy, easy way of use and simple logistics,

which make this method acceptable for farmers and also for distributors, even if the product is released by hand. Our market share in France is now more than 15%. It can be evaluated as a quiet good level if we consider that there are strong competitors selling several chemical insecticides and also the fact that farmers have not received financial help to use *Trichogramma*.

Utilization of *Trichogramma* for the Biological Control of the Cranberry and Sparganothis Fruitworms

Pelletier, D., F. Fournier & Guy Boivin (St-Jean-sur-Richelieu, CANADA)

The Cranberry Fruitworm (*Acrobasis vaccinii*) is a pest of major concern in cranberries across US and Canada while the Sparganothis Fruitworm (*Sparganothis sulfureana*) is considered as a secondary pest, mostly because it causes damage only when its natural enemies are eliminated by use of insecticides. In addition to the risk of pest resurgence, pesticide use increasingly rises concern with the consumers. An alternative to pesticides is the use of biological control methods, including parasitoids such as trichograms (*Trichogramma* sp.) that are minute egg parasitoids that are used as pest control agents in a variety of cultures. To evaluate the suitability of trichograms to control cranberry pests, strains have been collected in cranberry bogs in Québec during the summers 1998 to 2000. Following laboratory bioassays, two *Trichogramma* strains have been selected for field tests against *A. vaccinii* and *S. sulfureana.* Cumulated fruit loss caused by *A. vaccinii*, as well as damaged fruits at harvest and parasitism of *S. sulfureana* sentinel eggs, have been monitored. Three teatments were compared: two *Trichogramma* treatments (strains 7 and 9), and an insecticidal soap treatment. Results showed that, compared to control plot (4,1% cumulated damages), the two *Trichogramma* strains have significantly reduced the fruit loss caused by *A. vaccinii* with 1,8% and 2,1% for strains 7 and 9 respectively. Although the fruit loss monitored in the insecticidal soap plot (2,2%) was similar to that observed in the *Trichogramma* plots, it was not significantly lower than in the control plot. Damages at harvest evaluation showed no differences among treatments, although only strain 7 treatment resulted in less than 1% (0,8%) damage compared to 1,9%, 1,3% and 1,4% for strain 9, the soap treatment and the control plot respectively. We also tested parasitism of *S. sulfureana* sentinel eggs. Low rates of parasitism (4,7% and 1,3% for strains 7 and 9 respectively) were observed. We can explain this result by the low quality of the sentinel eggs used. However, we noted high predation rates (ca. 35%), which suggests that natural predators have a non negligible impact on borer populations in plots not treated with insecticides. Among the two *Trichogramma* strains monitored, the strain 7 showed better control against the Cranberry and Sparganothis Fruitworms. Great variation in fruit density and in *A. vaccinii* egg-laying activity among experimental sites may have attenuated differences between treatments and further field experiments are in progress.

Effects of pesticides, transgenic crops

Effects of Botanical Insecticides on the Egg Parasitoid *Trichogramma cacoeciae* Marchal (Hym. Trichogrammatidae).

Abdelgader, H. and S.A. Hassan (Darmstadt, GERMANY)

A study was carried out in the laboratory to investigate the side effects of two formulated products of each of two botanical insecticides, i.e. Azadirachtine (Neemazal T/S Blank and Celaflor®) and Quassin (alcoholic or water extracts), on *Trichogramma cacoeciae.*
In one set of experiments the host eggs parasitized at different periods were sprayed at the same day. Results indicated that only Neemazal T/S-Blank formulation was slightly toxic regarding adult emergence when 3 and 8 days old parasitized host eggs were sprayed. Neemazal T/S-Blank formulation was also slightly toxic in term of pupation, when one day parasitized host eggs were sprayed. No other harmful effects were observed in these experiments.
The other azadirachtine formulation (Celaflor) was slightly toxic relative to the control in term of the parasitism rate per female, when sprayed eggs were offered to adults of *T. cacoeciae* for parasitism directly after drying. 24 h, 48 h and 6 days residues were not significantly different from the control for all treatments.
The results in general showed that Azadirachtine and Quassin were relatively safe to the tested parasitoid and could be used in combination with *Trichogramma* releases.

Side Effects of Plant Protection Products on *Trichogramma cacoeciae* Marchal (Hym. Trichogrammatidae).

Abdelgader, H. & S.A. Hassan (Darmstadt, GERMANY)

The side effects of 13 plant protection products (9 insecticides/acaricides, 2 fungicides and 2 herbicides) on adults and immature stages of the egg parasitoid *Trichogramma cacoeciae* Marchal (Hymenoptera, Trichogrammatidae) were studied. The results showed that one insecticide (Mimic) and one herbicide (Logran) were safe to the adults, whereas 6 insecticides and one fungicide were harmful. The other tested pesticides were either slightly or moderately harmful. Testing on immature stages of *T. cacoeciae* showed that only one insecticide (Phosdrin) was harmful and one (Masai) moderately harmful.

Preliminary trials against *Ostrinia nubilalis* Hb. (Lep,: Pyralidae) controlled by *Trichogramma evanescens* Westwood (Hym.: Trichogrammatidae) alone or in combination with *Bacillus thuringiensis*

El Mandarawy, Mona B. R., Saadia A. Abdel Samae and Moustafa A.Z. El Nagar
(Dokki, Giza, EGYPT)

In Egypt, the European corn borer *Ostrinia nubilalis* Hb. is the major serious pest for maize fields planted after June, where reduced about 33.6% as general of the yield. The effectiveness of *Trichogramma evanescens* Westwood (Hym.: Trichogrammatidae) alone or with *Bacillus thuringiensis* on the target pest was evaluated under laboratory and field conditions. The parasitoid was mass reared on *Ephestia* or *Sitotroga* eggs and released in unsprayed or Bt sprayed maize fields (in Northern of Egypt) in season 2001. The integration of Bt as bioinsecticide with *T. evanescens* result in additional *O. nubilalis* control and induced a reduction in the infestation of plant nodes, ears and tassels.

No side-effects of gel-formulated cockroach insecticides on *Trichogramma evanescens*

Schöller, Matthias; Anke Reppchen, Sabine Prozell & Andreas Beckmann (Berlin, Hostmar, GERMANY)

In many situations, stored-product and urban pests occur simultaneously. Cockroaches like the German cockroach *Blatella germanica* or the Oriental cockroach *Blatta orientalis* are common pests in bakeries, food processing facilities and kitchens. As these cockroaches are potential vectors of diseases, they have to be controlled completely. Traditionally, cockroaches are controlled by spraying contact insecticides. Modern approaches include insecticides formulated within a gel. For the biological control of stored-product moths the egg-parasitoid *Trichogramma evanescens* Westwood is applied commercially in Germany and Austria. *T. evanescens* is known to be very susceptible to contact insecticides, and no strategies of integration have been described so far for stored-product protection. Therefore, possible side-effects of gel-formulated insecticides on *T. evanecens* have been tested. In Germany, three compounds have been shown to be effective against the German cockroach, Fenitrothione, Hydramethylnone and Fibronil. For testing side-effects of these insecticides in the laboratory, the guidelines of the IOBC were applied. However, as these guidelines are designed for sprayed insecticides, a suitable modification for the gel-formulated insecticides had to be found. All three insecticides were found to have no side-effects on *T. evanescens*, i.e. parasitism and emergence of progeny was not affected. Comparison of literature data on the active compounds showed that this is due to the formulation as a gel. Therefore, the release of *T. evanecens* and the application of the three mentioned insecticides are a promising strategy to integrate chemical control of cockroaches and biological control of stored-product moths.

Data on the occurce of egg parasitoid species in different countries

Country / reporter	species	native/ imported	reared	crops	host pest
Argentina Virla, E.G.	Anagrus flaveolus	Native	yes	maize	*Dalbulus maidis* (Cicadellidae), *Delphacodes kuscheli*, *Peregrinus maidis* (Delphacidae)
				oats, wheat	*Toya propinqua*; *Delphacodes kuscheli; Delphacodes haywardi*; *Pissonotus* spp., *Peregrinus maidis* (Delphacidae)
	Anagrus breviphragma	Native	yes	maize	*Dalbulus maidis* (Cicadellidae)
			no	oats	*Toya propinqua*; *Delphacodes kuscheli* (Delphacidae)
	Paracentrobia subflava	Native	no	weeds, wheat	*Exitianus obscurinervis and others leafhoppers* (Cicadellidae)
	Gonatocerus spp. (4x), Oligosita spp. (1x), Bloodiella spp. (1x)	Native	no	weeds, sugarcane, citrus	*Tapajosa rubromarginata* (Cicadellidae, Proconinii)
Egypt El-Heneidy, A.H.	*Trichogramma evanescens*	Native	yes	cotton, maize, sugar cane, date palm, olive	lepidopterous pests
India Usha Rani, P.	(about 20 species of Trichogrammatidae)				
	Trichogramma chilonis	Native	yes	sugarcane, tomato, cotton, maize, citrus	lepidopterous pests, sugarcane borers (*Chilo* spp.), tomato fruit borer (*Heliothis armigera*), cotton bollworms, maize stem borers
	Trichogramma japonicum	Native	-	-	lepidopterous pests
	Trichogramma brasiliensis	No	-	-	lepidopterous pests
	T. pretiosum	No	-	-	lepidopterous pests
Japan Takasu, K.	*Ooencyrtus nezarae* (Encyrtidae)	Native	yes	soybean	*Riptortus clavatus*, *Megacopta punctatissima* (Hemiptera)
USA, Hawaii Messing, R.	*Fopius arisanus*	imported (from Asia)	yes	fruits	*Ceratitis capitata*

List of publications on egg parasitoids

(from 1992 to 2000, not included in previous issues /

sorted by year and alphabetically according to first author)

Mymaridae

2001

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Scelionidae

2002

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Address list of research workers from 73 countries

ALBANIA

Hajnaj, Dr. G.;Ministre de l'Agric.,Protecsion de Plant;Pirana;ALBANIA
Papingji, Dr. A.;Stacioni Mbrojtjes Bimeve;Durres;ALBANIA

ARGENTINA

Botto, Dr.E.N.;Insectario Invest.es para Lucha Biol.;IMYZA-CICA, INTA ;(1712) Castelar,Buenos Aires; ARGENTINA
Carrizo, P.;Univ. Nat. de La Plata;Calle 60 y 119 s/n;La Plata 1900,P Buenos Aires; ARGENTINA
Fidalgo, Dr. Patricio;(Crilar - La Rioja); ARGENTINA;pfidalgo@crilar.com.ar
Loiacono, Dra. Marta ;Museo de Cs. Naturales de La Plata ; ARGENTINA; loiacono@museo.fcnym.unlp.edu.ar
Segade, Gonzalo;Insectario Lucha Biol., Imyza-CIBA;INTA. Castelar;1712 Buenos Aires.; ARGENTINA
Stadler, Dr. Teodoro;Lab. de Parasit.,Inst. Nacional de Invest. de las Ciencias Naturales;"Bernardino Rivadavia",Avenida Angel Gallardo 470;C1405DJR Buenos Aires; ARGENTINA
Tezze, Andrea A.;Lic. en Ciencias Biol.;IMYZA-INTA Castelar Campana 5338 (1419);Cap. Fed.-Buones.Aires; ARGENTINA; atezze@cnia.inta.gov.ar
Virla, Eduardo Gabriel;Proimi-Biotec. (Biological Control Division);Av. Belgrano & Pje. Caseros (4000);S.M. de Tucumán; ARGENTINA;+54 0381 434 4888,FAX +54 0381 434 4887;evirla@infovia.com.ar, evirla@hotmail.com
Zapater, Ing. Agr. Miguel C.;Cátedra de Genetica, Facultad de Agron., Univ. de Buenos Aires;Av. San Martin 4453;1417 Buenos Aires; ARGENTINA

AUSTRALIA

Bennett, David M.;School of Genetics & Human Variation, La Trobe Univ.;Bundoora, Victoria 3083; AUSTRALIA
Crouch, Michael & Glenn Bowmann;c/o Stahmann Farms; P.O.Box 236, NSW;Moree 2400;AUSTRALIA
Glen, Ms. Dean & Ms. Tracey Bjorksten;School of Gen. & Human Variation, La Trobe Univ.;Bundoora, , Victoria 3083.; AUSTRALIA
Goodwin, S.;Horicult Res. Station;P.O.Box 720;Gasford, N.S.W. 2250; AUSTRALIA
Hoffmann, Dr. A.A. & Ms. DeAnn Glenn;La Trobe Univ.,Dept. of Genetics & Human Variation;Bundoora, Victoria 3083;AUSTRALIA
Jarjees, Ekhlass A. ;Dept. of Entomol., Hartley Teakle Building., Univ. of Queensland; Brisbane, Queensland 4072; AUSTRALIA
Kölliker, Ursula;Evol. Biol. & IPM Unit, La Trobe Univ.;Victoria 083; AUSTRALIA; genumk@gen.latrobe.edu.au;61-03-94792982;94792480;
Munro, Ross;Nat. Insect Lav.;"Old Flour Mill";Gosport St.Moree 2400; AUSTRALIA
Popich, Susana;Weerawan Amornsak,Dept. of Entomol.,Univ.of Queensland, ;St. Lucia, Brisbane;Queensland 4072; AUSTRALIA
Ridland, Dr. Peter;Inst. for Horticult. Develop.; Private Bag 15621 Burwood Highway Knoxfield,South Eastern Mail Centre;Victoria 3176; AUSTRALIA
Scholz, Brad;Queensland Dept. of Primary Indust.;P.O.Box 102;Queensland 4350 Toowoomba, Queensland; AUSTRALIA

AUSTRIA

Berger, Dr. H.;Bundesanst. für Pflanzenschutz;Spargelfeldstr. 191;A-1220 Wien; AUSTRIA
Holzinger, Dr. Werner;Ökoteam, Inst. für Faunistik;Bergmanngasse 22;8010 Graz; AUSTRIA; t 43-0316-351650

BELGIUM

Bolckmans, Ir. Karel;Biobest;Ilse Velden 18B;2260 Westerlo; BELGIUM

BOLIVIA

Flores, Dr. Felix;CIAT; Av Ejercito Nacional 131, Casilla 247;Santa Cruz de la Sierra; BOLIVIA
Pruett, Dr. C.J.H.;CIMCA; Casilla 2731; Santa Cruz de la Sierra; BOLIVIA

Rogg, Dr. Helmuth W.;Inst. de Ecol. Serv. de Plagas,Serv. Aleman de Cooperacion (DED);Avenida 6 de AgostoCasilla 6546;La Paz; BOLIVIA

BRAZIL

Orlando, Dr. Sales Jr;UFMT,CCB;Av.Fernando Correa da Costa s/n;78060-900 Cuiaba; BRAZIL; ccb@cpd.ufmt.br, osalesjr@terra.com.br;t 55-65-615-8656;
Bibliotec EMBRAPA;BR-428 - KM-152 - CAIXA POSTAL 23;56300-000 PETROLINA - PE, ; BRAZIL
Almeida, Raul Porfirio de;Embrapa Algodao;Campina Grande-PB; BRAZIL
Barreto, Dr. Vicente;R. Voluntários da Pátria 196 Botafogo;Rio de Janeiro- RJ CEP 22270-010; BRAZIL
Bueno, Pr. Vanda;Dept.o de Entomol.,Univ. Fed. de Lavras;Caixa Postal 37;37200-000 Lavras,MG.; BRAZIL
Carneiro, Jocicler da Silva;EPACE/DPI;km3 Rodovia Tiangua-Vicosa;62.320-000 Tiangua-Ceara; BRAZIL; t 085 671 1233;x 085 671 1233;
Carvalho, Geraldo Andrada;Univ. Fed. de Lavras, Dep. de Entomol.;37200-000 Lavras, MG; BRAZIL; gacarval@ufla.br;t +55 35 3829-1801;x 55 35 3829-1288
Ciociola Jr., Dr. Americo Iorio;Dept. of Entomol., Phytopath. & Agric. Zool.;Caixa Postal 9, CEP: 13.418-900, ESALQ/USP;Piracicaba-SP; BRAZIL; ciociola@carpa.ciagri.usp.br
Degrande, Pauloe;UFMS/DCA;P.O.Box 533;79804-970 Dourados, MS; BRAZIL
de Sá, Luiz Alexandre Nogueira; Lab. de Quarentena "Costa Lima";Embrapa Meio Ambiente, P.O.Box 69;13.820-000 Jaguariúna, SP; BRAZIL; lans@cnpma.embrapa.br; t +55 19 867-5633;x 55 19 867-5225
Haji, Dra. Francisca Nemaura Pedrosa;EMBRAPA Semi-arido;BR 428, Zona Rural, C. P. 23, CEP: 56300-000;Petrolina PE; BRAZIL
Hohmann, Dr. Celso Luiz;Inst. Agron. do Parana (IAPAR);Cx. Postal 1331;86001 Londrina, Parana; BRAZIL
Monteil Gomes, Silvia;Escola Superior de Agri. "Luiz de Queiroz" Esalq, Univ. de S. Paulo (ESALQ/USP);Depto. de Entomol. CxP. 9, 13418-900 Piracicaba;S. Paulo ; BRAZIL
Oliveira-Paron, Maria Jose de;Embrapa-CPATSA; CP. 23, CEP 56-300-000;Petrolina-PE; BRAZIL
Parra, Dr. José R.P. & R.A. Zucchi;Esalo Univ. de Sao Paulo,Dept. de Entomol.; CP 9;13400 Piracicaba, Sao Paulo; BRAZIL;jrpparra@carpa.ciagri.usp.br;t +55 019 433 6255;x 42 94 199
Porfirio, Raul;EMBRAPA Rua Osvaldo Cruz, 1143;Centenário 58107.720 Campina Grande PB; BRAZIL
Prezotti, Mr. Lusinério;Rua 15 de novembro, 737, Praia da CostaVila Velha- ES, ;CEP: 29100-031; BRAZIL
Ranyse, Barbosa Querino da Silva;ESALQ/USP, Dept. de Entomol.;Av. Padua Dias, 11, CP 9, CEP 13418-900;Piracicaba-Sao Paulo; BRAZIL;rbqsilva@carpa.ciagri.usp.br;t 019 429-4199;x 019 433-0652
Sales Junior, Dr. Orlando;Av.Fernando Correa da Costa,s/n;78.060-900-Cubiaba-MT-BRAZIL; BRAZIL
Zucchi, Roberto Antonio;Dept. de Entomol., Univ. de Sao Paulo;CP 9, Esalo;13400 Piracicaba SP.; BRAZIL

BULGARIA

Karadjov, Prof. Dr. S.;Plant Prot. Inst.;P.O.Box 238; Kostinbrod,Sofia; BULGARIA
Kostadinov, D.;Lab. of Biol. Control,Plant Prot. Inst.;5 Shose Bankja Str.;Sofia 1731; BULGARIA
Tsankov, Prof.Dr. G.;Forestry Inst.;Sofia-C;Gische 15.; BULGARIA

BURMA

Rendell, Dr. C. H. & Dr. T.J.Crowe; FAOR c/o UNDP;P.O.Box 101;Rangoon; BURMA

CANADA

Fournier, François;Insecterra Inc.;2300, Sherbrooke Est, Bureau 400;Montréal, QC H2K 1E5; CANADA; 514-524-2433, Fax: 514-528-6849;ffournier@insectary.com
Boivin, Guy ; Ctre de Rech. & Dével. Horticulture, Agric. & Agroalim. ;430 Boul. Gouin ;Saint-Jean-sur-Richelieu ;Québec J3B 3E6 ; CANADA ; (450) 346-4494 poste 210
Bouchard, Denis;Bio-Contrôle; 2300, Sherbrooke est, #400;Montreal Qc H2K 1E5; CANADA
Huber, Dr. John T.;Biol. Res. Div., CLBRR, C.E.F.;K.W.Neatby Building;Ottawa, Ontario K1A OC6; CANADA
Hulme, Dr. M. A.;Canad. Forestry Serv., Pacific Forestry Centre;506 West Burnside Road;Victoria B.C. V8Z 1M5; CANADA
Kirsch, Dr. Philipp;IPM Technologies, Inc.;4134 N. Vancouver 305;Portland, OR 97217; CANADA
Laing, Dr. John A. & Jim E. Corrigan;Univ. of Guelph, Dept.of Environ. Biol., Biol. Control Lab.;Guelph, Ontario N1G 2W1; CANADA
Mackauer, Dr. M.;Center for Pest Manag.,Dept. of Biol. Scie.,Simon Fraser Univ.;Burnaby, B.C. V5A 1S6; CANADA
Mason, P.;Res. Station;107 Science Place, Saskatoon;Saskatchewan, S7N 0X2; CANADA
Meloche, Dr. Francois;Plant Res. Center;Ottawa, Ontario K 1A 0C6; CANADA
Paul;Cereal Res. Centre;195 Dafo Road;Winnipeg, Manitoba R3T 2M9; CANADA
Pelletier, Dominique;Insecterra Inc.;430, boul. Gouin;St-Jean-sur-Richelieu, QC J3B 3E6; CANADA ; (450) 346-4494,Fax (450) 346-7740 ; pelletierdo@em.agr.ca

Schmidt, Dr. Jonathan M.& Dr. S.M. Smith;Univ. of Toronto, Dept. of Zool.,Ramsay Wright Zool. Lab.;25 Harbord Street;Toronto, Ontario M5S 1A1; CANADA
Smith, Dr. Sandy M.; Univ. of Toronto, Fac. of Forestry;Toronto,Ontario,M5S 3B3; CANADA
Vincent, Dr. Charles;Station de Recherches;C.P. 457;St. Jean, Quebec J3B 6Z8; CANADA
Wallace, D.;Forestry CANADA, Ontario Region;P.O.Box 490, Sault Ste. Marie;Ontario P6A 5M7; CANADA

CHILE

Bannen, Carlota V.;Avda. Bulnes 140,Casilla 4088, C.Ossandón 2020;Santiago,; CHILE
Estay, Dr. Patricia;P. Agropecuarias;Santa Rosa 11610 - Parad, 33 -La Pintana,Casilla 439/3; Santiago; CHILE
Gerding, Marcos P.,Ing.;Inst. de Invest. Agropecuarias, Estacion Exp. Quilamapu;Avda. Vicente Mendez 515;Casilla 426, Chillan; CHILE
Ojede Aburto, Susana;Bioforest S.A.;Edificio Prales of 610;Valdivia,; CHILE
Ripa S., Dr. Renato & Fernando Rodriguez A.;INIA Chorrillos 86;La Cruz; CHILE
Sackenheim, Dr. Rolf;Univ. de Tarapaca, Inst. Agron.;Casilla 6 - D;Arica; CHILE
Vargas, Dr. R.;INIA;Chorrillos 86;La Cruz, VD Region; CHILE

CHINA P.R.

Elemento-Organic Chem. Inst.,Nankai Univ.;300071 Tianjin; CHINA, P.R.
Bin, Dr. Cong;Shenyang Agric. Univ.,Dept. of Plant Prot.;Liaoning Province 110161; CHINA, P.R.
Chang, Prof. Joseph T.;Peking Univ., Dept. of Biol.;Beijing; CHINA, P.R.
Cheng-Lun, Dr. Wang & Cui De-Jun;Inst. of Plant Prot. Inst., Jilin Acad. of Agric. Scie.;Congzhuling City,Jilin Province 136100; CHINA, P.R.
Gui-Jun, Wang;Forest Biocontrol Center, Station of Jilin Province;18 Weixing Road;Changchun, Jilin-Province; CHINA, P.R.
Guoguang, Prof. Mu;Nankai Univ.;94 Weijin Road;Tianjin 300071; CHINA, P.R.
Han, Shichou;Guangdong Entomol. Inst.;Xingang West Road 105;Guangzhou 510 260; CHINA, P.R.
Hui-Yi, Dr. Ma;Inst. of Plant Prot.,Helongjian Agriculutral Acad.; Harbin; CHINA, P.R.
Jian-Guo, Dr. Feng;Inst. of Plant Prot.,Shangdong Agric. Acad.;Jinan; CHINA, P.R.
Jian-Wen, Dr. Peng;Hunan Inst. of Forestry Scie.;164 Shaoshan Road;Changsha 410004, Hunang Province; CHINA, P.R.
Jun-De, Dr. Quin & Prof. H.F. Chu; Zool. Inst. Acad. Sinica;Beijing; CHINA, P.R.
Juwen, Prof. Wu;Inst. of Plant & Environ. Prot., Beijing Acad. of Agric. & Forestry Scie.;P.O.Box 2449-19;Beijing 100081; CHINA, P.R.
Kai-Jia, Dai;Univ. of Wuhan,Dept. of Biol.,Insect Physiol. Lab. Luojiashan;Wuchang, Wuhan; CHINA, P.R.
Liu, Prof. Shu-sheng;Inst. of Appl. Entomol.,College of Agric. & Biotech.,Zhejiang Univ. 3-398;268 Kaixuan Road; Hangzhou 310029; CHINA, P.R.;shshliu@zju.edu.cn; Fax:(86-571) 6049815;Tel:(86-571)6971 505
Li-Ying, Prof. Dr. Li & Dr. Guo Ming-Fang; Guangdong Entomol. Inst.;Xingang West Road 105;Guangzhou 510260; CHINA, P.R.
Mao, Runqian;Guangdong Entomol. Inst.;West Xingang Raod 105;Guangzhou 510260; CHINA, P.R.
Mu-Quan, Dr. Song;Centre of Agric. Technical Advice;Liu-he County Jilin; CHINA, P.R.
Naiquan, Dr. Lin;Fujian Agric. College, Biol. Control Res. Inst., Dept. of Plant Prot.;Fuzhou, 350002, Fujian Province; CHINA, P.R.
Qing-Guang, Dr. Lu;Biol. Control Inst.,Chin. Acad. of Agric. Scie.;30, Bai Shi Qiao Road; Beijing 100081; CHINA, P.R.
Shaotang, Dr. Huo;Shaanxi Acad. of Agric. Scie.;Yangling, Shaanxi Province; CHINA, P.R.
Shen, Dr. Al P.;Shanghai Inst. of Entomol.,Acad. Sinica;Shanghai 200025; CHINA, P.R.
Shu-Sheng, Dr. Liu;Zhejiang Agric. Univ., Dept. of Plant Prot.;Hangzhou 310029; CHINA, P.R.
Shu-Yi, Zhang & Wang Fu-Cheng;Cotton Res. Inst.,Shanxi Agric. Acad.;Yuncheng, Shanxi 044000 ; CHINA, P.R.
Stleng, Song de;Agric. Station;Xian Ren Dong 116407;Ztluang He Da Lian; CHINA, P.R.
Tiansheng, Assoc. Prof. Pu;Res. Inst. of Plant Prot.,Guangxi Acad. of Agric. Scie.;Nanning, Guangxi Province; CHINA, P.R.
Wang, Zhen-ying, Ph.D;Dept. of Agric. Entom.,Inst. of Plant Protection;Chinese Acad. of Agric. Sciences;#2 West Yuanmingyuan Road, 100094; Beijing; CHINA, P.R.;(10)-62815945,Fax (10)62895451; wangzy@public.east.net.cn
Wen-Qing, Dr. Lu;Shanghai Normal Univ.,Dept. of Biol.;Shanghai; CHINA, P.R.
Xiao-Cheng, Dr. Shen;Henan Acad. of Agric. Scie.,Inst. of Plant Prot.;Zhenzhou, Henan Province; CHINA, P.R.
Xi-Lin, Dr. Sun;Chin. Forestrial Acad., Entomol. Div.;Beijing; CHINA, P.R.
Xiong-Fei, Prof. Dr. Pang;South China Agric. Univ.;Guangzhou; CHINA, P.R.
Ying-Jian, Dr. Zhang;Jiangsu Coastland, Inst. of Agric. Scie.;9 Tongyu Mid Road;Yancheng 224002; CHINA, P.R.

Yu, Enyu;351 PB., 42-sub Hongqi Str.;Changchun, Jilin Province, 130012; CHINA, P.R.
Zhang, Dr. Wen-Qing;State Key Lab. for Biocontrol & Inst. for Entomol.,Zhongzhou Univ.;West Xingang Road, 135;Guangzhou 510275; CHINA, P.R.; LS37@zsu.edu.cn; fax: 86-20 841 / 2958;t / 912 15
Zhang, Ms. Fan;Biol. Control Inst., Jilin Agric. Univ.;Changchun 130118;Jilin Province; CHINA, P.R.
Zhao, Dr. Jun-Sheng;Inst. of Plant Prot., Shanxi Agric. Acad. of Scie.;Taiyuan 030031; CHINA, P.R.
Zhi-Cheng, Liu;Plant Prot. Res. Inst.,Guangdong Acad. of Agric. Scie.;Shih Pai;Guangzhou; CHINA, P.R.
Zhi-Xin, Dr. Wu;Inst. of Zool., Acad. Sinica;Beijing 100880; CHINA, P.R.
Zhong, Dr. Liang-Bing;Dept. of Plant Prot., Huazhong Agric. Univ.;Wuhan-Hubei 430070; CHINA, P.R.
Zu-Hua, Shi;Zhejiang Agric. Univ., Dept. of Plant Prot.;Hangzhou 310029; CHINA, P.R.

COLOMBIA

CIAT;Apartado Aéreo;6713 Cali; COLOMBIA
Arias, B. & A.M. Caicedo V.,A. Ortega G., D.F. Múnera;CIAT - Centro Int. de Agric. Trop.;A.A. 6713;Cali; COLOMBIA
Bustillo P., Alex E.;Cenicafé;Apartado Aéreo 2427;Manizales; COLOMBIA
Garcia Roa, Fulvia;CORPOICA, Corp. Colombiana de Invest. Agropec.;Vía Penitenciaria Palmira;A. 1301; COLOMBIA
Gomez, Luis;Cenicana;A.A. 9138;Cali.; COLOMBIA
Hernández, Yolanda Gutiérrez;Incauca S.A.;A.A. 6705; COLOMBIA
Jimenez, Jades V.;Carrera 29 No. 35-51;.A. 1015 Palmira Valle; COLOMBIA
Lopez-Avila, A.;Inst. Colombiano Agropecuario IVA;Apartado Aereo 151123;Eldorado Bogota, D.E.; COLOMBIA
Madrigal C., Alejandro;Univ. Nacional de Colombia Sede Medellín;Apartado Aéreo 3940; COLOMBIA
Mazuera, Luiz;Carrera 25 No. 20-37;Palmira-Valle; COLOMBIA
Mejía, Hernando;Probiocol;Calle 5 # 6 A 132;Zarzal - Valle; COLOMBIA
Mosquera, Aristóbulo López-Avila;CORPOICA, Corp. Colombiana de Invest. Agropec.;Vía Penitenciaria Palmira;A. 1301; COLOMBIA
Muñoz, Carlos Gómez;Inst. Colombiano Agropec.;A.A. 233;Palmira; COLOMBIA
Navarro, Manuel Amaya;Carrera 4 # 4-69 Buga;Valle del Cauca; COLOMBIA
Puente, Marco A.;Carrera 62 Bis 6 A 78;Cali; COLOMBIA
Quintanilla, Jorge Mejía;Univ. de Córdoba;Km. 4 Vía a Cereté;Montería, Córdoba; COLOMBIA;
t. (947) 860111;
Rodas, Carlos Alberto;Smurfit Cartón de Colombia;Apartado Aéreo 219;Cali; COLOMBIA
Rojas, Genny;Inbeagro;Carrera 26 A # 58-09;Palmira; COLOMBIA
Ruiz, Rodrigo A. Vergara;Univ. Nacional sede Medellin; COLOMBIA
Sarmiento, Carlos E.;A.A. 52656;Santafé de Bogota D.C.; COLOMBIA
Valdez, Julio;Calle 2 A # 66B - 86, Apto. 202 B;CALI; COLOMBIA;t 331-71-80;mob. 93-428-3656;
Varela, Luis Mario;Calle 6ª 0 14 - 54, Barrio Ciudad Jarhin;Zarzal, Valle; COLOMBIA
Vargas, Diego Fernando;INTEP-Inst. Educ. Técn. Profesional;Calle 15 # 10ª -14;A.A. 30, Roldanillo - Valle; COLOMBIA
Vivas, José Galo P.;Calle 59 # 27-23;Palmira, Valle; COLOMBIA

COSTA RICA

Fernández, Ana Lucía Alvarez;Dept. de Control Biol., Min. de Agric. y Ganaderia;Apartado 10094 - 1000; COSTA RICA

CUBA

Armas, J.L. & Jorge L. Ayala;Lab. Provincial de Sanidad Vegetal;Apdo. 106;60700 Sancti Spiritus; CUBA
Caballero, Maida Mollineda;Inst. de Invest. de Sanidad Vegetal;Calle 110 Nº 574 el 5ta B y 5 5ta F. ;Miramar Playa C. Habana; CUBA
Sandoval, Fermin Fuentes;Nat. Centre of Plant Prot.;Calle 238#3301, Apto 9/33y35, San Agustin Lisa C.;Habana; CUBA

CZECHOSLOVACIA

Birova, Dr. Helen;Inst. Exp. Phytopathologie & Entomol.;900 28 Ivanka pri Dunaji; CZECHOSLOVACIA
Cagán, Ludovít & Tancik Jonbo;Dept. Plant Prot., Univ. of Agric.;Lomonosovova 2;94976 Nitra; CZECHOSLOVACIA
Pavlik, J.;Inst. of Entomol.,Czechoslovak Acad. of Scie.;Branisovská 31;Ceské Budejovice 37005; CZECHOSLOVACIA

DENMARK

Hansen, L. Stengaard; Danish Pest Infestation Laboratory DPIL;Min. of Food, Agriculture & Fisheries;Skovbrynet 14;DK-2800 Kgs. Lyngby; DENMARK;
l.s.hansen@SSL.DK;+45 45 87 80 55; direct: +45 45 97 43 56, Fax. +45 45 87 14 55

ECUADOR

Nicente, N. & S. Paliz;Jete del Dpto. de Entomol.,EET-Pichilingve de INIAP;Quevedo; ECUADOR
Oviedo, Marco V. Neira;Pontificia Univ. Católica del Ecuador;Casilla 17-11-5157;Quito; ECUADOR
Ponce, Fernando;Riobamba, Escuela Radiofónicas Populares; ECUADOR

EGYPT

Abbas, Dr. Mohamed Samir;Plant Prot. Res. Inst., Dept. of Biol. Control;Nadi El-Said Str.;Dokki, Cairo; EGYPT
Abdel-Hamid, Dr. Zidan;Fac. of Agric Ain Shams Univ.,Sumitomo ,Chem. Co.;Abul Fida Bldg., 10th Floor, Abul Fida Street;Zamalek; EGYPT
Agamy, Essam;Dept. of Econ. Entomol.,Cairo Univ., Fac. of Agric. ;Cairo; EGYPT
Altahtawy, Prof. Dr. Makbal M.;Univ. of Alexandria, Fac. of Agric.,Dept. of Plant Prot.; Alexandria ; EGYPT
Awadalla, Dr. K. T.;Cairo Univ.,Fac. of Agric.,Dept. of Entomol.;Cairo, Giza; EGYPT
El-Heneidy, Ahmed H.; P.O. Box # 915, Code 11728;MAADI, CAIRO; EGYPT;+ (202) 5733482, + 20123233610 Fax: + (202) 3596740;aheneidy@link.net
El-Heneidy, Dr. Ahmed H.;Plant Prot. Res. Inst., Dept. of Biol. Control;Nadi , El-Said Str.; Dokki, Cairo; EGYPT
El-Mandarawy, Mona B. R.;21A, Rayel Street;Helwan El-Hamamat, Cairo; EGYPT;tel. 5560316; mona_el_mandaraw@hotmail.com
El-Sherif, Prof. Dr. Samir;Dept.of Econ. Entomol. & Pesticides, Fac. of Agric., Cairo Univ.;Cairo; EGYPT
Fayez, Dr. & Nazir Zakir;Nat. Res. Center;Cairo; EGYPT
Hafez, Prof. Dr. Bahaa;Econ. Entomol. Dept., Fac. of Agric., Alexandria Univ.;El Satbi; Alexandria; EGYPT
Hegazi, Prof. Dr. Esmat M.;Fac. of Agric.,Univ. of Alexandria;El-Shatby, Alexandria; EGYPT
Nasr,Dr. Feeby N. & Dr. Aly Yousef; Plant Prot. Res. Inst. ,Agric. Res. Cent. Alexandria;Sabahia Res. Station; Alexandria Baccous 21616; EGYPT
Saleh, Mahmoud M. E.;Nat. Res. Center, Plant Protect Dept.;El-Tahrir-Street;Dokki, Cairo ; EGYPT
Shonouda, Mourad Lois;Fac. of Science, Alexandria Univ.;Alexandria; EGYPT;
t +203 5977 662;x +203 4836 618;

EL SALVADOR

Montoya H., Ramón;Plant Prot. Project GTZ;P.O.Box 693;San Salvador; EL SALVADOR

ERITREA

Gebrekal, Bisrat;P.O.Box 166;Asmara; ERITREA

FIJI

Liebregts, Wilco, Eco-Consult;P.O.Box 5406,Raiwaqa Post Office;Suva; FIJI, Pacific Islands; ecoconsult@is.com.fj;t 679322607

FINLAND

Hämäinen, M.;Univ.,Dept. Agric. & Forest Zool.;00710 Helsinki; FINLAND

FRANCE

Int. Biocontrol Manufactural Association (IBMA);5, Quai Voltaire,;F-75007 PARIS; FRANCE
Aeschlimann, Dr. J. P.;CSIRO Biol. Control Unit;335 Ave Parguel;F-034100 Montpellier; FRANCE
Blum, Melle & Jacqueline Stepp Stilan;52 Rue de St. Ilan;F- 22380 Langueux,; FRANCE
Bournier, Dr. J.P.;IRCT / CIRAD;BP 5035;F-34032 Montpellier; FRANCE
Frandom, J.;Biotop-Lutte Biol., UNCAA; Route de Biot. D 4;06560 Valbonne; FRANCE
Grenier, Simon;Inst. Nat. des Scie. Appl. de Lyon,Lab. de Biol. Appl.;20,Ave Albert-Einstein, Bat. 406;F-69621 Villeurbanne Cedex; FRANCE
Hawlitzky, Dr. Nicole;I.N.R.A.- C.R.A., Station de Zool.;Route de St. Cyr;F-78026 Versailles Cedex, ; FRANCE
Hoelmer, Dr.Kim Alan;Campus Int.de Baillarguet;CS 90013 Montferrier sur Lez;34988 St.Gely du fesc Cedex; FRANCE
Hurpin, Dr. B.;P. Ferron Station de Recherche de Lutte Biol.;La Miniere;F-78280 Guyancourt; FRANCE

Kabiri, Firouz;BIOTOP;Route de Biot-D4;F-06 560 Valbonne; FRANCE; t 00 33 (0)4 93 12 37 90, Fax : 00 33 (0)4 93 12 14 06;fkabiri@biotop.fr
Kaiser, Laure;INRA/CNRS;B.P.23, Rue de la Guyonnerie;91440 Bures sur Yvette; FRANCE
Lauge, Ginette;Lab. de Reprod., Develop. del'Insecte;Bat.445, Univ. de Paris sud XI.;91405 Orsay-Cedex; FRANCE
Neto, Luis;INSA, Biol. 406;20 Ave A. Einstein;F-69621 Villeurbanne-Cedex; FRANCE
Pintureau, Dr. B.;Inst. Nat. des Scie. Appl. de Lyon; 20, Ave Albert-Einstein, Bat. 406;F-69621 Villeurbanne Cedex; FRANCE
Stengel, Dr. M.;Station de Zool. INRA;28, Rue de Herrlisheim,B.P. 507;F-68021 Colmar; FRANCE
Volkoff, Dr. A. N.;Station de Cytopathologgie;30380 St.Christol-lez-Ales; FRANCE
Wajnberg, Dr. E. & Jeanne Daumal;Lab. de Biol. des Invertébres, Unité de Biol. de Popul.; 37, Bd. du Cap, ;06600 Antibes; FRANCE

GERMANY

Albert, Dr. Reinhard;Landesanst. f. Pflanzenschutz;Reinsburgstr. 107;70197 Stuttgart; GERMANY
Englert, Dr. W. D.;Biolog. Bundesanst. f. Land- u. Forstwirt.,Inst. für Pflanzenschutz im Weinbau; Brüningstr. 84;D-54470 Bernkastel-Kues; GERMANY
Greiler, Dr. Hans-Joachim;Fachgeb. Agrarökologie,Georg-August-Univ.;Waldweg 26;D-37073 Göttingen; GERMANY
Hassan, Dr. S.A.;Inst. for Biol. Pestcontrol, BBA;Heinrichstr. 243;64287 Darmstadt; GERMANY; s.hassan.biocontrol.bba@t-online.de; t +49 6151 / 407 223;x +49 6151 / 407 290
Holst, Prof. Dr. Hartwig;Fachgeb. Phytomedizin, Forschungsanstalt f. Weinbau & Gartenbau; Postfach 11 54;65366 Geisenheim; GERMANY
Kast, Dr. W. K.;Staatl. Lehr- & Versuchsanst. f. Wein- & Obstbau;Postfach 13 09;74189 Weinsberg; GERMANY
Louis, Dr. Friedrich;LLFA f. Landwirt., Weinbau & Gartenbau;Breitenweg 71;67435 Neustadt/Weinstraße; GERMANY
Monje, Dr. Juan-Carlos;Univ. Hohenheim, Inst. Phytomedizin;Dept. of Entomology;70593 Stuttgart; GERMANY; 49-711-4592398,Fax49-711-4592408;jcmonje@uni-hohenheim.de
Schoeller, Dr. Matthias;Biol. Beratung;Hosemannstrasse 8;10409 Berlin; GERMANY
Wührer, Dr. Bernd;AMW Nützlinge GmbH;Außerhalb 54;64319 Pfungstadt; GERMANY; amwnuetzlinge@aol.com;t 06157 / 99 05 95;x 06157 / 99 05 97
Zebitz, Prof.Dr. C.P.W.;Inst. für Phytomedizin (360),Univ. Hohenheim;70593 Stuttgart; GERMANY
Zimmermann, Olaf;Inst. for Biol. Pestcontrol, BBA;Heinrichstr. 243;64287 Darmstadt; GERMANY; ozimmermann@hotmail.com;t +49 6151 / 407 270;x +49 6151 / 407 290

GREECE

Angelakis, Dr. M.;Station de Contrôle Phytosanitaire;17, rue M. Gouvernetou;Heraklion - Crete; GREECE
Stavraki, Dr. H.;Inst. Phytopathologique Benaki;Kiphissia; GREECE

GUATEMALA

Castaneda, Oscar;15 Av. 0-26 Zona 1;Quetzaltenango; GUATEMALA

HONDURAS

Castro, M.;Res. Honduras;P.O.Box 397;Gulfport MS 39501; HONDURAS
Cave, Dr. Ronald D.;Depto. de Proteccion Vegetal;Escuela Agricola Panamericana,Apartado 93;El Zamorano; HONDURAS; ron%eapdpv@sdnhon.org.hn;t 504 76 6140;x 504 76 6242

INDIA

Commonwealth Inst. of Biol. Control;P.O.Box 2484, Hebbal Agric. Farm Post Office;Bangalore 560 024; INDIA
Control Unit;Min. of Agric., N.H. IV.;Faridabad, UP; INDIA
ICRISAT;Patancheru;Andhra Pradesh 502 324; INDIA
Balasubramanian, S.;C.I.P.M.C.;Kolo, KR Road;Bangalore, Karnataka; INDIA
Divakar, Dr. J.;Plant Protection Training Inst.;Rajendranagar, Hyderabad 500 030; INDIA
Gupta, Dr. Meera;Min. of Agric., Directorate of Plant Prot., Integr. Pest Manag. Centre;6-3-655/2/1; Somajiguda, Hyderabad (A.P.); INDIA
Gupta,Seema;Zool. Dept.,Panjab University;Chandigarh-160 014; INDIA
Harwalkar, Dr. M. R.;Pest Manag. Section, Nuclear Agric. Div.;Bhabha Atomic Res. Centre;Trombay, Bombay 400 085; INDIA
Manickavasagam, S.;Fac. of Agricult., Annamalai Univ.;Annamalai Nagar - 608 002;Tamilnadu; INDIA

Manjunath, Prof. T. M.;Biocontrol Res. Laboratories;P.O:Box 3228, Rabindranath Tagore Nagar;Bangalore 560 032 - Karnataka; INDIA
Mariyakulandai, A.;Dept. of Entomol.,Fac. of Agric.,Annamalai Univ.;Chidambaram 608 002;Tamil Nadu; INDIA
Markandeya, Dr. V.;Nat. Plant Prot. Training Inst.;Hyderabad (A.P.), 500 030, ; INDIA
Misra,Dr.R.P.;Centr. IPM Centre;B-11/`H`Road,Mahanagar Extension;Lucknow,U.P.; INDIA
Muthukrishnan, Dr. N.; Dept. of Entomol.,Agr. College & Res. Inst.; Madurai 625 104;Tamilnadu,; INDIA
Kaushik, Dr. H. D.;443, Sector 15A;HISAR - 125 001; INDIA
Lakshminarayana, Dr. M.; Entomology Div.;Directorate of Oil seed Res;Rajendranagar, Hyderabad 500 030; INDIA
Nagaraja, Dr. H.;51, 8th Main, 16th Cross Nr. 233;Malleswaram, Bangalore 560 055; INDIA
Nagarkatti, Dr. Sudha;Indian Council for Agric. Res., Indian Inst. of Horticult. Res.;Bangalore; INDIA
Navarajan, Paul A.V.; Indian Agricult. Res. Inst.;New Delhi 110012; INDIA
Pajni, Prof. H.R.;Panjab Univ. (Chandigarh),Dept. of Zool.;Chandigarh-160 014; INDIA
Pawar, C.S.;ICRISAT;Patancheru;Andhra Pradesh 502 324; INDIA
Prabhu, B.;Basarass Biocontrol Res. Lab.;3/204, Main Road, Eraiyur;Pennadam R.S.,S.A. District - 606111.; INDIA
Raheja, A.K.;Indian Council of Agric. Res.;Krishi Bhawan, Dr. Rajendra Prasad Road;New Delhi 110001; INDIA
Ram, Dr. Pala; Dept. of Entom.; CCS Haryana Agric. Univ.;Hisar-125 004, Haryana, INDIA; +91 1662 43231, Fax +91 1662 34952; pala_ram@rediffmail.com
Ramesh, Mr. B.;Dept. of Entomol., Fac. of Agric., Annamalai Univ.;Annamalainagar, 608002 TN.; INDIA
Rao,D. & Dr. C.V.Rama; Coll. of Agric.;ANGRAU,Bapatla (A.P.); INDIA
Reddy, G. Ramasubba;Central Plant Prot. Training Inst.;Rajendranagar;Hyderabad 500030 Andhra, Pradesh; INDIA
Shanower, Thomas G.;ICRISAT-Patancheru;Andhra Pradesh, 502324.; INDIA
Sharma, Dr. S.S. ; Dept. of Entom.; CCS Haryana Agric. Univ.;Hisar-125 004, Haryana, INDIA; t +91 1662 43634, Fax +91 1662 34952;hau@hau.hry.nic.in
Singh, S.P.;Biol. Control Centre,Nat. Centre for Integr. Pest Manag.;Bellary Road, P.B. 2491, H.A.Farm Post;Bangalore 560024; INDIA
Singh,J.P.;Centr. IPM Centre;73 B/B Gandhi Nagar;Tammij 180004; INDIA
Solayappan, Dr. T.;Main Bio-Control Res. Lab. 2E/1;Rajeswari Vedachalem Str.;Chengalpaddu 603001, Tamilnadu; INDIA
Swamiappan, Prof. Dr. M.;Tamil Nadu Agric. Univ. Coimbatore; 641003 Tamilnadu; INDIA
Usha Rani, Pathipati,Biology division, Indian Inst. of Chemical Techn.;Taranaka, Hyderabad 500 007 (AP); INDIA;t 7160123 extn. 2364.,Fax. + 91- 40-3359022;Purani@iict.ap.nic.in, usharani65@yahoo.com
Venugopal, Dr. M. S.;Dept. of Agricult. Entomol.;Agric. College & Res. Inst.;Mandurai 625 104 Tamilnadu; INDIA

INDONESIA

Bindra, O. S.;UNDP/FAO/Indonesia Project No.INS/83/025/A/01/12;Balai Penelitian Tembakau dan Tanaman Serat,36, Jl. Industri Timur;Malang - 65122EAST JAVA; INDONESIA
Cilandak, Jagorawi;Outer Ring Road 26;Jakarta Selatan; INDONESIA
Jagorawi, Jl.; Rhizogin Indonesia Biotech. for Agric.;Ventura Building, 3rd Floor, Suite 303,Cilandak, Outer Ring Road 26;Jakarta Selatan; INDONESIA
Nurindah;Entomol. Div., Res. Inst. for Tobacco & Fibre Crops;Jl. Raya Karangploso, P.O.Box 199; Malang; INDONESIA
Rhizogin;Biotech. for Agric.;Ventura Building 3rd Floor,Suite 303;JI.; INDONESIA

IRAN

Assady, Dr. H. Bayat;Plant Pest & Diseases Res. Inst. (PPDRI),Dept. of Biol. Control;P.O.Box 1454;Tehran 19395; IRAN
Chodsai, Dr. M. & Abbas Ali Nasrollahi;Iranian Res. Organisation for Science & Techn.;No. 71 Forsat Enghelab Av., P.O.Box 15815-3538;Tehran 15819; IRAN
Ebrahimi, Ebrahim;Plant Pests & Diseases Inst.;P.O.Box 1454/19395;Tehran; IRAN ;e-ebrahimi@areeo.or.ir;
Ghartzadeh, Ebrahim;Dept. of Agric. Entomol.;Isfahan Univ. of Techn.;Isfahan 84154; IRAN
Mostaan, M.;P.O.Box 365;Oromieh; IRAN
Nadjafi Navai, Eng. I.;Plant Pest & Diseases Res. Lab.;Rice Res. Station Amol;Mazadaran Province; IRAN
Rafii,Mrs.Shala & Khalatbari Hayedeh;#135,Second Street,North Karghar Street;Tehran,14139; IRAN
Shojai Dr.M.;Iranian Res. Org. of Science and Technol.;No.71 Forsat St.Enghelab Ave.,P.O.Box 15815.3538;Tehran 15819; IRAN
Tirgari,Dr.S.;P.O.Box3918;11356 Tehran;IRAN

IRAQ

Alrubeai, Dr. H.F.;Agri. & Biol. Res. Centre;P.O.Box 765;Bagdad; IRAQ
Hussain, F. Alrubeai;Econ. Entomol. Dept., Agri. Res. Center;PO Box 765;Baghdad; IRAQ
Tarik, Dr. Ahmed Mohammed;College of Agric., Univ. of Bagdad, Dept. of Plant Prot.;Bagdad; IRAQ

ISRAEL

Gerling, Prof. D.;Tel-Aviv Univ., Dept. of Zool.;Ramat Aviv;Tel-Aviv 69978; ISRAEL
Nakache, Dr. Yakov;Biol. Control Serv.;Kibbutz de Eliyahu 10810; ISRAEL
Wysoki, Dr. Manes (Pres. Israel EntSoc);Dept of Entomol., Inst. of Plant Prot.;The Volcani Center, P.O.Box 6;Bet Dagan 50250; ISRAEL

ITALY

Plant Prot. Serv.,FAO;Via delle Terme di Caracalla;I-00100 Roma; ITALY
Arzone, Prof. Dr. Alessandra;Dipt. di Entomol. e Zool., Appl. all'Ambiente;Via Pietro Giuria 5I;10126 Torino; ITALY
Bin, Ferdinando;D.A.P.P.-Entomology;Univ.Perugia;Borgo XX Giugno;Perugia 06121;ITALY;
t +(39) 075 585 6030, fax +(39) 075 585 6039;fbin@unipg.it
Casale, Dr. Achille;Dip. to Zool. Univers.;Via muroni 25 ;I-07100 Sassari; ITALY
Chiappini, Dr. Elisabetta;Istit. di Entomol. e Patologia vegetale, Fac. di Agraria, Univ. Catt. del Sacro Cuore;Via Emilia Parmense, 84;29100 Piacenza; ITALY;bettac@pc.unicatt.it;
t +39 0523 599 240;x +39 0523 599 235;
Colazza, Stefano;Inst. di Entomol. Agraria della Univ.;Borgo XX Giugno;I-06100 Perugia; ITALY
Conti, Dr. Eric; D.A.P.P.-Entomology, Univ. Perugia; Borgo XX Giugno; Perugia 06121 ITALY;
t +(39) 075 585 6029, fax: +(39) 075 585 6039;econti@unipg.it
Isidoro, Prof. Nunzio; Dept. Biotecnologie Agrarie & Ambientali;Univ. di Ancona, via Brecce Bianche; Ancona, 60131; ITALY;+(39) 071 220 4639; isidoro@unian.it
Maini, Dr. Stefano;Inst. di Entomol.,Univ. di Bologna;Via Filippo Re, 6;I-40126 Bologna; ITALY
Mineo, Dr. G.;Inst. di Entomol., Agraria della Univ.;Viale delle Scienze;I-90128 Palermo; ITALY
Paoletti, Dr. M. G.;Dipt. Biol.;V. Trieste 75;Padova; ITALY
Romani, Dr. Roberto, D.A.P.P.-Entomology, Univ. of Perugia;Borgo XX Giugno;Perugia 06121;ITALY;
t +(39) 075 585 6032, fax: +(39) 075 585 6039; isidoro@unipg.it
Salerno, Dr. Gianandrea; D.A.P.P.-Entomology, Univ. of Perugia;Borgo XX Giugno;Perugia 06121; ITALY;+(39) 075 585 6034,fax: +(39) 075 585 6039;entomol@unipg.it
Tiberi, Dr. R.;Inst. Sperimentale per la Zool. Agraria;Via Lanciola - Cascine del Riccio;I-50125 Firenze; ITALY
Viggiani, Prof. Dr. G.;Inst. di Entomol. Agraria, Univ. di Napoli;I-80055 Portici; ITALY
Vita, Dr. G.;Div. Techn. Biol. et Agrar. dell' ENEP; C.P.;I-2400 Rome; ITALY

IVORY COAST

Martin, Mr. Kehe;IRFA;01 B.P. 1740;Abidjan 01; IVORY COAST
Vaissayre, D. M. & G. Ochou;Idessa Centre Textilos;B.P. 604;Bouake; IVORY COAST

JAPAN

Hirai, Dr. K.;Nat. Agric. Res. Center, Min. of Agric.;Tsukuba City 305; JAPAN
Hirose, Dr. Y.;Inst. of Biol. Control, Fac. of Agric., Kyushu Univ.;Fukuoka 812; JAPAN
Matsuura, Dr. Hiroichi;Ishikawa Agricl.Expt.Stn.;Kanazawa-City 920-01; JAPAN
Mochida, Dr. Osamu;Nat. Agric. Res. Centre;Ibaraki-ken, Tukuba-si;Kan'nondai, 305; JAPAN
Mori, Hans;Hokkaido Univ.;Sapporo 060; JAPAN
Takasu, Keiji;Graduate School of Agric., Kyushu Univ.;Hakozaki 6-10-1, Higashi-ku;Fukuoka 812-8581; JAPAN;tel 81-92-642-3027, fax:81-92-642-3028;takasu@brs.kyushu-u.ac.jp
Takeuchi, Hiroaki; Nat. Agric. Res. Center;Tsukuba-City 305.; JAPAN
Wakisaka, Shigekazu; Biol. Lab. Agric., Chem. Div.;Otsuka Chem. Co. Ltd.;Naruto city 772.; JAPAN
Yabu, Tetsuo;Nat. Agric. Res. Center;305-8666;Kannondai 3-1-1 Tukuba; JAPAN
Yochizawa, Eiji;Nagano Agric. Expt. Stn.;Suzaka-City 392.; JAPAN

KENIA

Saxena, Dr. R.C. (Rice Proj. Coord.);The Intern. Centre of Insect Physiology & Ecol.;P.O.Box 30772;Nairobi; KENIA

KIRGHYSTAN

Biol. Control Lab.;Issik-kul oblast, ul. Leninsky-Komsomol;Karakol; KIRGHYSTAN

Tihomirova, Galina;Min. of Agric.,Sokuluk Region v. Novo-Pavlovka;ul. Pogranichnaya 28;722130 ; KIRGHYSTAN

KOREA, REP. of

Han, Man-Wi;Dept. of Entomol.;ASI RDA;Suwon 441-101; REP. OF KOREA
Hyung-Rae, Lee;Div. of Biol. Agric. Chem. Res. Inst.;Office of Rural Develop.;Suweon 190; REP. OF KOREA

KUWAIT

Al-Houty, Dr. W.;Dept. of Zool., Fac. of Sience,Kuwait Univ.;P.O.Box 5969;Safat 13060; KUWAIT

MALAYSIA

Awang, Alias;Malaysian Cocoa Board;P.O. Box 60079;91010 Tawau, Sabah; MALAYSIA
Guan-Soon, Lim;Malaysian Agric. Res. & Develop. Inst. (MARDI);P.O.Box 2301;Kuala Lumpur; MALAYSIA
Kook, Lim Bew;Crop Prot. Branch, Dept. of Agric.;Jalan Gallagher;Kuala Lumpur; MALAYSIA
Lim, Dr. G. T.;Syraikat Sri Mengkabong SDN BHD;W.D.T. 506;90009 Sandakan Sabah; MALAYSIA
Tong, Dr. Lee Ming;Malaysian Cocoa Board;Beg Berkunci 211, 88999;Kota Kinabalu, Sabah; MALAYSIA

MAROCCO

Bourarache, Dr. K.;Lab. de Zool.,Inst. Agro. et Vét.;Hassan II Rabat Agdal; MAROCCO
El Jadd, Dr. L.;Station de Recherches Cotonniéres, INRA;Béni-Mellal; MAROCCO

MEXICO

Alvarado-Rodrigues, Dr. Benito;Campbell Res. Develop.,Apart. Postal 185;Guasave, Sinaba 81000; MEXICO
Cardenas, Q.A. Rosina Ojeda;Centro de Ciencias de Sinaloa;Avenida de las Americas,#2771 NTE.; Culiacan,Sin.; MEXICO;rosina@information.ccs.net
Carillo, Dr. Jose L.M.;CIFAPSON, CE;Valle del Yaqui, Apdo. Postal Nº 515;CD. Obregon, Son. C.P. 85 000; MEXICO
Castanon, Luis;Marconi # 165;San Luis Potosi, S.L.P.78200; MEXICO
Cedéno, Dr. R.M.;CIICA; Central Otc. 34, Tapachula ;Chiapas 30700; MEXICO
Diaz, Jorge Cancino;Segunda Avenida Sur # 5 Altos;30700 Tapachula Chiapas; MEXICO; Fax: 91 (962) 6-4955
Magallanes-Cedeno, Dr. R.;Programa de Entomol., CIICA, A.C.;Central Ote.;Tapachula, Chiapas 30 700; MEXICO;t 962 0773:x 5 1065
Martínez Carrillo, Dr. José L.;CIFAPSON, CE; Valle del Yaqui, Apdo. Postal Nº 515;CD. Obregon, Son. C.P. 85000; MEXICO
Rubio Ruelas, Lic. Baldemar;Centro de Ciencias de Sinaloa;Av. de Las Americas No. 2771 Nte., Apdo. Postal 1889;Culiacan, Sinaloa; MEXICO

NEPAL

Giri, Mahendra K.;P.O.Box 707;Katmandu; NEPAL

NETHERLANDS

Koppert Biol. Systems;Veilingweg 8A;NL-2651 HC Berkel-Rodenrijs; NETHERLANDS
Polaszek, Dr. A.;Wageningen Agric. Univ.,Dept. of Entomol.;P.O.Box 2031;NL-6700 EH Wageningen; NETHERLANDS
Ramakers, P.M.J.;Proefstation voor de Groenten an Fuitteelt onder Glas;Postbus 8;Naaldwijk; NETHERLANDS
Ravensberg, Dr. W. J.;Veilinsweg 64;NL-2651 BE Berkel en Rodenrijs; NETHERLANDS
Silva, Isabel M.M.S.;Lab. of Entomol.,Wageningen Univ.;Binnenhaven 7;6709 PD, Wageningen; NETHERLANDS;isabel.silva@users.ento.wau.nl;t +31 317 484 650;x +31 317 484 821
Stolk, C.;Wageningen Agric.Univ., Dept.of Entomol.;P.O. Box 8031;6700 EH Wageningen; NETHERLANDS;clemens.stolk@medew.ento.wau.nl;t +31 317 482 321
Theunissen, J.;IPO;Binnenhaven 12;NL-6700 EH Wageningen; NETHERLANDS
van der Linden, Anton;Res. Station for Nursery Stock;P.O. Box 118;2770 AC Boskoop; NETHERLANDS; t+31 172 236728;Fax+31 172 236710
van Lenteren, Prof. Dr. J.C. & Dr. A. van Huis;Wageningen Agric. Univ.,Dept. of Entomol.;P.O.Box 2031; NL-6700 EH Wageningen; NETHERLANDS
van Schelt, Dr. J.,;Koppert Biol. Systems;P.O.Box 155,;NL-2650 AD Berkel en Rodenrijs; NETHERLANDS

NEW ZEALAND

Martin, Dr. N. A. & Dr. Pritam Singh;Entomol. Div. DSIR;Private Bag;Auckland; NEW ZEALAND

NICARAGUA

de Lugo, Dra. Luisa;Dept. de CIP;UNAN Leon; NICARAGUA

PAKISTAN

Amjad, Dr. Muhammad;PARC, Nat. Agric. Res. Centre;Park Road;Islamabad; PAKISTAN
Baloch, Dr. Umar K.;Pakistan Agric. Res. Council;20 G-5/1, P.O. Box 1031;Islamabad 44690; PAKISTAN
Neakakhtar, Hidayatullah (Attn.);Resource Centre for Develop. Alternatives(RCDA);Faraz House, Block D-237;Ghazikot-Township,Mansehra 21300; PAKISTAN
Shakeel, Dr. M.A.;CIBA-GEIGY Ltd.;P.O.Box 4;Industrial Estate Multan; PAKISTAN

PAPUA NEU-GUINEA

Prior, R.N.B.;Cocoa, Coconut Res. Inst.;P.O.Box 1846;Rabaul, East New Britain;PAPUA NEU-GUINEA;

PERU

de Araujo, Dr. Marie Whu;Centro de Introduc. y Crade Insectos Utilos;Vivero La Estrella Vitarte,C. Cavallo 292, Urb. St.Catalina;La Victoria, Lima; PERU
Gamarra Hilda S.;Portada del Sol 461;Urb. Zarate Lima 34,; PERU
Vitarte;Corresp. to:C.Cavallo;292 Urb.Sta.Catalina;La Victoria,Lima; PERU

PHILIPPINES

Bureau of Plant Industr.;692 San Andreas St.;Malate, Manila 1004; PHILIPPINES
Alba, Dr. Melanie C.;Sugar Regul. Admin. La Granja;La Carlotta City - Negros Occidental; PHILIPPINES
Bustamente, Rosenda & Lilian Teano;Bureau of Plant Ind.;692 S. Andres St.; Malate, Manila 1004 ; PHILIPPINES
Cadapan, Dr. E.P. & Dr. F.C. Quebral;Univ. of the PHILIPPINES at Los Banos;Philippine Council f. Agric. & Resources, Res. & Develop.; Manila; PHILIPPINES
Joshi, Dr. R. C.;c/o Dr. P.E. Kenmore;FAO P.O.Box 1864;Manila; PHILIPPINES
Lorenzana, Orlando;Reg. Crop Prot. Center, Dept. of Agric.;Ilagan, Isabela, Region 2; PHILIPPINES
Magallona, Dr. Edwin D.;Dept. of Entomol., Univ. of the PHILIPPINES at Los Head Banos;Center College;Laguna; PHILIPPINES

POLAND

Kot, Dr. J.;Inst. of Ecol.,Polish Acad. of Scie.;Dziekanow Lesny;05-092 Lomianki; POLAND

PORTUGAL

Univ. Algarve;8000 Fare;PORTUGAL
Araujo, Prof.Dr. J.;Univ. of Evora, Res. line 8, Center of Appl. Ecol.,INIC;Evora; PORTUGAL;
Frescata, Carlos;BIOSANI;Casal de Sto.Isidro, Serra do Louro;2950 Palmela; PORTUGAL
Garcia, Patricia & Dr. Joao Tavares;Dept. de Biol., Univ.dos Acores R.Mae de Deus;9500 Ponta Delgada; Acores; PORTUGAL
Meierrose, Dr. Carola;Univ. of Evora, Res. Line 8;Center of Appl. Ecol.,INIC;Evora; PORTUGAL
Silva, Isabel;Univ. of Evora,Dept. of Biol.;Apartado 94;7001 Evora Codex; PORTUGAL

ROMANIA

Andriescu, Prof. Dr. Ionel;Inst. de Rech. Biolog., Lab. de Taxonomie & Evolut. Lutte Biol.;Bd. Copou 20 A;6600 Iasi; ROMANIA
Boeriu, Horia;Biol. Control Lab.;Str. Fundaturii No.2;2200 Brasov.; ROMANIA
Ciochia, Dr. Victor;Lab. Lutte Biol. et Prot. de la Nature;Str. Fundaturii No 2;2200 Brasov; ROMANIA
Fabritius, Dr. Klaus;Inst. de Igiena;Str. Dr. Leonte 1 - 3;76256 Bucuresti; ROMANIA
Gavrila, Sandru;Inspect. de Prot.;Plantelor str. Dezrobirii nr. 80;4300 Tg. Mures; ROMANIA
Muresan, Felicia;Agric. Res. Station;Str. Agriculturii Nr. 27;3550 Turda; ROMANIA

RUSSIA

Kartsev, Dr. V. M.;Dept. of Entomol., State Univ., Biol. Fac.;Moscow, 119899;RUSSIA
Lebedev, Dr. G. & W.I. Martinenko;All-RUSSIAn Plant Prot.;Orlikow Perjeulok 1/11;107139 Moscow; RUSSIA
Reznik, Dr. Sergey Ya.;Exp. Entom. & BioControl, Zool. Inst., 199034, St.Petersburg, RUSSIA;
Fax: +7 (812) 114 0444, Phones: +7 (812) 114 O442, +7 (812) 114 5167;reznik@weed.zin.ras.spb.ru

Sorokina, Alexandra Petrovna;All-RUSSIAn Inst. of Plant Prot.;Podbelskii Road 3;189620 St. Petersburg-Pushkin; RUSSIA
Timoknov, A.V.;Dept. of Entomol., Fac. of Biol.,Moscow State Uni.;Moscow 119899; RUSSIA
Tshernyshev, Prof. Dr. W.B.;Dept. of Entomol.,State Univ.;Moscow 119899; RUSSIA
Zaslavski, Dr. V. A.;Lab. of Exp. Entomol., Zool. Inst. of RUSSIA, Acad. of Scie.;199034 St. Petersburg; RUSSIA

SAMBIA

Msekera Res. Station;P.O.Box 510089;Chipata; SAMBIA

SLOVAKIA

Tancik,J. & Tr.A. Hlinku 2;Univ. of Agric., Dept. of Plant Prot.;94901 Nitra; SLOVAKIA; kor@uniag.sk;t 42 87 601 255

SOUTH AFRICA

Begemann, Deon;Zebediela Citrus;P.O.;Zebediela 0627; SOUTH AFRICA
Begemann, Dr. G.J.; Tranovaal Sugar ltd.; P.O.Box 602 ;Komatipoort 1340; SOUTH AFRICA
Carnegie, Dr. A. J. M.;South African Sugar Assoc., Exp. Station;Private Bag X02 ;Mount Edgecombe, Natal 4300; SOUTH AFRICA
Conlong, Dr. D.E.; South African Sugar Assoc., Exp. Station; Private Bag X02; Mount Edgecombe, Natal 4300; SOUTH AFRICA;
Hamburg, Huib van;Dept. Zool.,Potchefstroom Univ. Ofche;Potchefstroom 2520; SOUTH AFRICA
Kfir, Dr. R. & Dr. R. du Plessis;Plant Prot. Res. Inst.;Priv. B. X134;Pretoria 0001; SOUTH AFRICA
Moore, Sean;Citrus Research Intern.;PO Box 20285;Centrahil 6006;Port Elizabeth; SOUTH AFRICA; t +27 41 5835524, +27 41 5833657 (fax);seanmoore@cri.co.za

SPAIN

Caballo, Tomas;Centro de Invest. y Desarrollo Agrar., Dept. de Protec. Vegetal;Apd. de Correos 2027;18080 Granada; SPAIN
Cabello, Prof. Dr. T.;Univ. de Almeria, Escuela Politecnica Superior, Dpto. Biol. Apl.;E-04120 La CANADA (Almeria); SPAIN
Vargas, Dr. P.;I.N.I.A., C.R.I.D.A.;10 Apartado 240;Cordoba; SPAIN

SRI LANKA

Kandaiah, Ms. Saroginie;Div. of Entomol., Cari; P.O.Box 11;Peradeniya; SRI LANKA
Pallewatta, Dr. Nirmalie;Dept. of Zool., Univ. of Colombo;P.O.Box 1490;Colombo; SRI LANKA

SUDAN

Abdelgader, Hayder; Agric. Res. Corp., Crop Protection Res. Ctr., Entomology Section;P.O. Box 126; Wadmedani; SUDAN,00249-511-40060, priv. 49784,fax 00249-511-43213;abdelgaderh@yahoo.com

SWITZERLAND

Baur, Dr. Robert;Zool., Swiss Fed. Res. Station;CH- 8820 Waedenswil; SWITZERLAND
Bigler, Dr. F.;Eidgen. Forschungsanst. f. landwirt. Pflanzenbau;Postfach;Zürich-Reckenholz,CH-8046 Zürich; SWITZERLAND
Burger, Regina;Landi;Lyon-Strasse 18,Dreispitz;CH- 4053 Basel; SWITZERLAND
Carl, Dr. K. P.;CIBC; 1, Chemin des Grillons;CH-2800 Delemont; SWITZERLAND
Dutton, Anna C.;Swiss Fed. Res. Inst. for Agronomy;CH-8046 Zürich; SWITZERLAND
Freuler, Dr. J.;Station fédérale;Route de Duillier;CH-1260 Nyon; SWITZERLAND
Pierrard, Dr. G.;UNDP Rangoon, Burma c/o European Office of U.N.;CH-1211 Geneve 10;SWITZERLAND;
Romeis, Dr. Joerg;Swiss Fed. Res. Station for Agroecology and Agric. (FAL);Reckenholzstr. 191;CH-8046 Zurich; SWITZERLAND;+41-1-377 72 -99, fax -01;joerg.romeis@fal.admin.ch
Scheidegger, Martina;Andermatt BIOCONTROL AG;Stahlermatten 6;CH-6146 Grossdietwil; SWITZERLAND;sales@biocontrol.ch;t +41 62917 50 00;x +41 62917 50 01
Städler, E.;Eidgen. Forschungsanstalt;CH-8820 Wädenswil; SWITZERLAND
Zuber, Dr. M.;Andermatt Biocontrol AG;Stahlermatten 6;CH-6146 Grossdietwil; SWITZERLAND

SYRIA

Aguilar, L;Univ. d' Alep-BP 12352,Fac. d' Agron., ,Lab. de Rech. en Lutte Biol.;Alep; SYRIA
Almatni, Wa'el; Dept. of plant Protection, Min. of Agric.;P.O. Box 511;Jaramana, Damascus; SYRIA; t +963 11 561 3960;almatni@scs-net.org
Al Muallem, Rasmia;Dir. of Agro Scie. Res. Douma;P.O.Box 113;Douma; SYRIA

Babi, Dr. A.;Univ. d'Alep, Fac. d'Agron.;Alep; SYRIA
Lababibi, Dr. M.S.;Dept. of Plant Prot.,Fac. of Agric.,Univ. of Aleppo;12052; SYRIA
Al Nabhan, M.;Univ. d´Alep, BP 12352, Fac. d`Agron.;Lab. de Rech. en Lutte Biol.;Alep; SYRIA;
t 963 21 229184

TAIWAN

Chen, Dr. Bing-huei;Dept. of Appl. Zool.,Taiwan Agric. Res. Inst. Wufeng;Taichung; TAIWAN
Chiou-nan, Dr. Chen;Plant Prot. Div.,Council of Agric.;37 Nanhai Road;Taipei 10728; TAIWAN
Suey-sheng, Dr. Kao & Mr. Tzeng Ching-chou;Taiwan Agric. Chem.s & Toxic Substances Res. Inst.;
189 Chung Chen Road;Wufeng 41301, Taichung; TAIWAN

THAILAND

Amornsak, Weerawan;Dept. of Entomol., Fac. of Agric.,Kasesart Univ.;Kamphaengsaen Campus;Nakhon-Pathom 73140; THAILAND; agrwwa@nontri.ku.ac.th;t +66 02 5790113, 561 1984 ext. 216,217(KPS), 66 034 351886;x 351406
Heuel-Rolf, Brigitte;TG - PPP;P.O.Box 9 - 100 Bankhen;Bangkok 10900; THAILAND
Nanta,V.& Dr. V. Nithiuthai,W. Katanymul,M. Rumakom;Div. of Entomol. & Zool.,Dept. of Agric.;Bankhen;Bangkok 10900; THAILAND
Pattrasudhi, R.;Div. of Entomol. & Zool.,Dept. of Agric.Bankhen;Bangkok 10900; **THAILAND**
Prachuabmoh,Dr.O.;Field Crop Res. Inst., Dept. Agr.;Bangkok 9; THAILAND
Sampet, Mr. Tiva;Plant Prot. Sub-Div.;Pattaya City;Chonburi 20260; THAILAND

TUNESIA

Jardak, Dr.Taibet;Inst. de l'Olivier;B.P. 263;3029 Sfax;TUNESIA

TURKEY

Ayvaz, Dr. Abdurrahman; Erciyes Univ. Science and Art. Fac. Dept. of Biology;38039;Kayser; TURKEY; ayvaz@erciyes.edu.tr, ayvaz@erciyes.edu.tr
Bulut, Dr. H.; , Gen. Dir. of Agric. Res., Min. of Agric. & Rural Affairs;Bagdat Cad. No. 208;06171 Yenemahalle-Ankara; TURKEY
Erkilic, Dr. L. & Dr. S. Öztemiz;Plant Prot. Res. Inst.;P.K. 21;011321 Adana; TURKEY
Kahvecy Caner, Yasemin;Black Sea Agrc.Res.Ynst.;P.K.;39 Gelemen/Samsun; TURKEY;
yasemin kahveci@yahoo.com; t +90 362 25 60515;x +90 362 25 60516;
Kilincer, Prof. Neset;Ankara Üniv. Ziraat, Fak. Bitki Koruma Bölümü;Kalaba, Ankara; TURKEY
Koclu, Turkan & Yusuf Karsavuran;Plant Prot. Res. Inst.;35040 Bornova;Izmir;TURKEY;
turkan_koclu@bornova.tagem.gov.tr.,yusuf@ziraat.ege.edu.tr;t 902 32 3880030; x 90 232 3741653
Kornosor, Prof. Serpil; Univ. of Cukurova, Fac. of Agric., Plant Protec.;01330 Adana; TURKEY
Öncüer, Prof. Dr. C.;Ege Üniv. Ziraat, Fac. Bitki Koruma;Bölümü;Bornova, Izmir; TURKEY
Öpinar, Dr. A.;Univ. of Harran, Fac. of Agric., Plant Prot.;63200 Sanliufa; TURKEY
Öztemiz, Sevcan;Min. of Agric. and Rural Aff. Plant Prot.Res.Inst.;Po.Box 21;01321 Adana;TURKEY;
s_oztemiz@hotmail.com, adzirmuc@future.net.tr;t +90 322 32 19581;x +90 322 32 24820
Tuncbilek, Dr. Aydin S.;Erciyes Univ.,Fac. of Arts and Scie.,Dept. of Biol.;38039 Kayseri;TURKEY;
t +09 352 43 74901 / 33056;tunca@erciyes.edu.tr,tuncbilek@yahoo.com
Uzun, Dr. S. & T. Koclu;Zirai Mücadele,Arastirma Enstitüsü;35040 Bornova, Izmir; TURKEY

UKRAINE

Fursov, Viktor;Inst. of Zool., Nat. Ukrainian Acad. of Scie.; Bogdan Khmelnitskii Street 15;252601, Kiev; UKRAINE; fursov@ukrpack.net;t +44 224 9333; x +44 224 1569

UNITED KINGDOM

Accessions Unit CAB Intern.;PO Box 100;Wallingford,Oxon OX10 8DF; UNITED KINGDOM
Adviser, Dr. F.;Farm Advisory Serv. Team Ltd, Exp. Farm;North Street, Sheldwich;Faversham, Kent, MF13 0LN; UNITED KINGDOM
Bassett, Dr. P.;ADAS Block C, Gouvernment Buildings;Brockland Ave;Cambridge CB2 2DR; UNITED KINGDOM
Bradbury, G.K.;W. Bailey Ltd.;East Hall Farm, East Hall Lane;Rainham;Essex, RM 13 9 DS; UNITED KINGDOM; gbradbury_wbailey@compuserve.com
Griffiths, Don & Dr. C.S.A. Stinson;Bunting Biol. Control Ltd.;Great Horkesley Colchester;Essex CO6 4AJ; UNITED KINGDOM
Polaszek, Dr. A.;Dept. of Entomol., British Museum (Natural History);Cromwell Road;London SW7 5BD; UNITED KINGDOM

Sampson, Clare;CIBA Bunting Westwood Park;Little Horkesley;Colchester, Essex; UNITED KINGDOM
Tatchell, Dr. G. Mark;Horticult. Res. Int.,Entomol. Scie. Dept.;Wellesbourne, Darwick CV 35 9 EF; UNITED KINGDOM
Vane-Wright, Dick;Head Dep.of Entomol.;Cromwell Road;London SW75BD;UNITED KINGDOM; r.vane-wright@nhm.ac.uk;t 02079425737
Waage, Dr. J.;IIBC Inst., Silwood Centre for Pest Manag.;Imp. College Ascot;Berks. SL5 7PY; UNITED KINGDOM
Wardlow, Dr. L. R.;MAFF, ADAS Advisory Centre;Olantigh Road, Wye Ashford; Kent TN25 5EL; UNITED KINGDOM
Worrall, I.E.;Natural Pest Control "Watermead";Yapton Road, Barnham, Bognor Regis;West Sussex PO22 0BQ; UNITED KINGDOM

URUGUAY

Basso, C. ; Fac. de Agron.;Av.Garzon 780;12900 Montevideo; URUGUAY;cbasso@adinet.com.uv;t 598230612;x 59823093004
Grille, Gabriela;Fac. de Agron.;Garzon 780;12900 Montevideo; URUGUAY

USA

Association of Appl. Insect Ecologists;10202 Cowan Heights Drive;Santa Ana, CA 92707; USA
BIOFAC INC.;Box 87;Mathis, Texas 78368; USA
Biol. Control Serv. Program, Information Center;3288 Meadowview;Sacramento, CA 95832; USA
Integr. Pest Manag.;305 Agostino Road;San Gabriel, CA 91776; USA
SEA US-Dept. of Agric.;Beltsville, MD 20705; USA
Ashley, Tom R.;USDA, Aphis, IS;P.O. Box 3149;Laredo, Texas 78044; USA
Barbosa, Dr. Pedro;Dept. of Entomol.,Univ. of Maryland;College Park, MD 20742; USA
Burbutis, Prof. P. & Prof. Ch. Mason;College of Agric. Scie., Dept. of Entomol., Univ. of Delaware; 249 Agric. Hall;Newark, Delaware 19711; USA
Cárdenas,L.;Teh Schripps Res. Inst., Dept. of Cell Biol. (Dr. Fauqeut's Office);10666 North Torrey, Pine Road;La Golla, CA 92037; USA
Consoli, Fernando Luis; Entomol. Res. Lab.;College Station Texas;77843-2475 Texas; USA; t (409)845-4772 847-8668
Easton, Emmett R., Res. Entomol.; 46 - 130 Kiowai Street # 2714; Kaneohe, HI 96744; USA
Ehler, Dr. I.E.;Univ. of California, Dept. of Entomol.;Davis,CA 95616; USA
Ertle, Dr.R.Lawrence;Agric. Res. Serv., North Atlantic Area, Benef. Insects Res. Lab.; 501S. Chapel Street;Newark, Delaware 19713; USA
Frey, Richard C.;P.O.Box 4247 CRB;Tucson, AZ 85738; USA
Gonzales, Ph. D.W. Jorge;Tropical Res. Dept., Dole Fresh Fruit Co. (Honduras); P.O.Box 1077;Freeport, Texas 77541; USA
Gordh,Prof.G.;USDA-ARS, Subtrop. Agric. Res. Centre;2301 S. Intern. Blvd,Weslaco;Texas 78596;USA; t 956 5652423;x 956 5659584
Grbic, Miodrag;Dept. of Entomol.,Univ. of Wisconsin;237 Russell Labs., 1630 Linden Drive Madison; WI 53706; USA
Greany, Patrick;USDA-ARS; 1700 SW 23 Dr.;Gainesville, FL 32608; USA
Greenberg, Shoil M.;USDA-ARS, Texas Agric. Exp. Station, Texas A&M Univ. System;2413 East Highway 83, Weslaco; Texas 78596; USA;sgreenberg@weslaco.ars.usda.gov;t 956-969-4806 or 4824
Hallman, Guy J.;USDA-ARS;13601 Old Cutler Road;Miami, Florida 33158; USA
Hung, Dr. A.;Benef. Insects Lab., BARC-East, USDA;Beltsville, Maryland 20705; USA
James, Dr. R. Cate;Integr. BioControl Systems;1415 S. County Road;150 E. Dillsboro, Indiana 41018; USA
Jones, Dr. Richard L.;Dept. of Entomol., Univ. of Minnesota;219 Hodson Hall, 1980 Folwell Ave;St. Paul, Minnesota 55108; USA
Katti, Sudha;Lake Erie, Regional Grape Rsearch & EC;662 N. Cemetery Rood, North East;PA 16428; USA
Keller, Dr. M. A.;USDA, Insect Attractants;Behavior & Basic Biol. Res. Lab.;Trifton, Georgia; USA
King, Dr. E. G. & S. B. Stark;USDA, Southern Field Crop Insect,Manag. Lab.;P.O.Box 346;Stoneville, MS 38776; USA
Knutson, Allen;Texas A & M Univ. System, Texas Agric. Extension Serv.;17360 Colt Road;Dallas, Texas 75252; USA
Leppla, Dr. Norman;1641 Edgewater;Mount Dora, Fl 32757-6944; USA
Lewis, Dr. W. J.;USDA-ARS South Atlantic Area, Insect Biol. & Popul., Manag. Res. Lab.;P.O.Box 748;Trifton, Georgia 31793-0748; USA
Luck, Dr. R.F.;Univ. of California, Div. of Biol. Control;Riverside, CA 92521; USA
Maedgen, M.A. Jr.;P.O.Box 87;Mathis, Texas 78368; USA

Messing, Dr. Russell H.;Univ. of Hawaii,College of Tropical Agric.;7370 Kuamoo Road;Kapaa, Hawaii 96746; USA;808-822-4984 x223, fax 808-822-2190;messing@hawaii.edu
Michael, I.F.;Michael Pest Manag.;P.O.Box 9338;Fresno, CA 93791; USA
Mills, Dr.N.J.;Div.of Biol.Control, Univ.of California, Berkeley;1050 San Pablo Ave.;Albany,CA 94706; USA
Naranjo, Steve;USDA-ARS, Pacific West Area, Western Cotton Res. Lab;4135 E. Broadway Road;Phoenix, AZ 85040; USA
Nguyen, Ru;Div. of Plant Industr.;P.O. Box 147100;Gainesville, FL 32614; USA
Nordlund, Dr. Donald A.;USDA-ARS, SARL, Biol. Control of Pests Res. Unit;2413 E. Highway 83; Weslaco, Texas 78596; USA
Millar, Jocelyn G.; Dept. of Entomology, Univ.of California;California 92521; Riverside; USA; fax 19097873086; jocelyn.millar@ucr.edu
Olson, D. M. & D. A. Andow;Dept. of Entomol., Univ. of Minnesota;219 Hudson Hall, 1980 Folwell Ave; St. Paul, MN 55107; USA
Paine, Timothy D.; Dept. of Entomology, Univ.of California;California 92521; Riverside; USA; fax 19097873086
Peña, Dr. Jorge;Univ. of Florida, Inst. of Food & Agric. Scie., Trop. Res. & Educ. Center;18905 SW 280 Street; Homestead FL 33031;USA
Penn, Dr. S.L. & Dr. D. J. Pirani;Benef. Insectary;245 Oak Run Road;Oak Run, CA 96069; USA
Pinto, John D.;Dept. of Entomol.,Univ. of California;Riverside, CA 92521; USA
Pluke, Richard;Dept.of Entoml. & Nematol., Univ. of Florida;Gainesville, Florida 32608;USA; rwp@gv.ifas.ufl.edu, rpluke@hotmail.com;t 352-392-1901;x 352-392-0190
Ridgway, Dr. Richard L.;Agric. Environ. Quality Inst.;Bldg. 007, Rm. 326, BARC-W;Beltsville, MD 20705; USA
Ruberson, Dr John R.;Dept. of Entomol. ,Univ. of Georgia;P. O. Box 748;Tifton, GA 31793-0748; USA
Smith, Dr. Michael T.;Res. Entomol., USDA Mid South Area, Southern Insect Manag. Lab.;P.O.Box 346; Stoneville, MS 38776; USA
Stouthamer, Dr. Richard; Dept. of Entomol., Univ. of California;Riverside, CA 92521; USA
Swezey, Dr. S. L.;Center for AgroEcol. & Sustainable Food Systems, Univ. of California;Santa Cruz, CA 95064; USA
Triapitsyn, S. v.;Entomol. Res. Museum, Dept. of Entomol., Univ. of California;Riverside, CA 92521; USA
Vinson, Dr. B.;Dept. of Entomol., College Station;Texas 77843-2475; USA
Wood, Leeda;USDA, APHIS, PPQ, Mission BioControl Lab.;P.O.Box 2140;Mission, TX 78572-2140; USA
Wright G. Mark & P. M. Hoffmann;Dept. of Entomol.,Cornell Univ.Ithaca;NY 14853; USA
Wu, Zhi-Xin & Zhong-Neng Xie;USDA-ARS, Texas Agric. Exp. Station, Texas A&M Univ. System; 2413 East Highway 83, Weslaco; Texas 78596.; USA

VENEZUELA

Univ. Romulo Gallegos, Ciudad Univ.;Carretera via El Castero Cruce via Camburito, San Juan de los Morros;Estado Guarico; VENEZUELA
Ferrer, F.R.;Carrera 5, No.4-76;Urbanizacion del Este Barquisimeto; VENEZUELA
Hernandez, Dilcia;FONAIAP Trusillo;Edo. Trusillo.; VENEZUELA
Mills, Dr. N.J. & Gladys Moreno;Univ. Rómulo Gallegos;Decanato de Postgrado, San Juan de los Morros;Estado Guárico; VENEZUELA
Moreno, Gladys;Univ.Romulo Gallegos, Decanato DE Postgrado;San Juan de los Morros,Estado Guarico; VENEZUELA;lumenXXI@sjmorros.c-com.net
Velazquez, Mercedes;Univ. Rómulo Gallegos;San Juan de los Morros;Estado Guárico; VENEZUELA

VIETNAM

Hoi, Dr. Doan Van;Fac. of Biol., Univ. of Hanoi;Hanoi; VIETNAM
Nguyen Thi Diep;National Institute for Plant Protection;Hanoi; VIETNAM
Nong Thi Hai;Biological Faculty,Natural University;Hanoi; VIETNAM
Quyen, Prof. Pham Binh;Centre for Natural Resources, Manag. & Environ. Studies, Univ. of Hanoi;19 Le Thanh Tong;Hanoi; VIETNAM
Van San, Nguyen;Dept. of Insect Ecol., Hanoi Nat. Univ.;19 Le Thanh Tong Street;Hanoi; VIETNAM

Short description of the IOBC Working Group
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The Working Group **“Egg Parasitoids”** consists of about 200 research workers from 54 countries and aims to promote research on this group of beneficial arthropods.

Topics of interest:

1 Biosystematics and genetics

2 Host relation and biology

3 Physiology and behaviour

4 Ecology and population dynamics

5 Rearing (in vivo & in vitro), production and release

6 Compatibility (environmental, biological, chemical)

7 Effectiveness and assessment.

Chairman:

Prof. Dr. F. Bin,

Agricultural Entomology Institute, University of Perugia,

Borgo XX Giugno, 06121 Perugia, Italy. Tel.: 0039 75 585 6030, Fax. –75 585 6039

e-mail: fbin@egeo.unipg.it

Co-Chairman:

Dr. E. Wajnberg,

INRA, Laboratoire de Biologie des Invertébres, Unité de Biologie de Populations,

37, Bd. du Cap, 06600 Antibes, FRANCE. Tel.: 0033-04 93 67 88 92, Fax –04 93 67 88 97,

e-mail: wajnberg@antibes.inra.fr

Co-Chairman:

Dr. G. Boivin,

Research Station, Agriculture Canada, 430 Boul. Gouin, St-Jean-sur-Richelieu, Québec, CANADA J3B 3^{E} 6. Tel.: (450)-346-44 94, ext. 210, Fax (450)-346-77 40,

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Symposia are organized every 4 years (next 2002). Meetings are also regularly held within the International Congress of Entomology every 4 years (next 2004).

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A Symposium was also included as part of Section 8 of the
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XXI International Congress of Entomology, Brazil, August 2000.

IOBC Working Group "Egg Parasitoids" - QUESTIONNAIRE - EGG PARASITOID NEWS No. 14 / 2002

----------(Find a questionnaire-download also on website http://www.bba.de/eggpara/eggp.htm) ----------

Dear Colleagues,

this is the call for your contributions to the 14th issue of the Egg Parasitoid News.
Please fill out the form and send it by e-mail, fax or letter to:

Dr. S.A.Hassan, Federal Res. Centre, Institute for Biological Control,
Heinrichstr. 243, D-64287 Darmstadt, Germany,
Fax +49-6151-407290 e-mail: s.hassan.biocontrol.bba@t-online.de

Please reply as soon as possible but before the end of the year 2002.
The use of this form and sending it by e-mail is preferred.
Please forward this form to further research workers specialised on egg parasitoids.

Best wishes and thank you for your cooperation.

Lab. S. A. Hassan

Your address:
name, institute
street, city, country

tel / fax / e-mail

A) Your main research work with egg parasitoids:

__ Systematics, Genetics; __ Selection of suitable beneficial parasitoids; __ Ecology, Behaviour

__ Mass production, Utilization; __ Biology, Physiology; __ Side effects of pesticides

I do not conduct research but I would like to be informed __ .

B) Abstracts on your current research

Please write half a page abstract(s) on your current research project(s) with egg parasitoids giving the most interesting aspects on methods and results (title; author (s), city, country) .

C) Publications

Please contribute with a list of your publications on egg parasitoids
that did not appear in previous issues of Egg Parasitoid News.

(e.g.: El-Mandarawy, Mona B.R. (2001): Some biological parameters of *Trichogramma cacoeciae* Marchal, the egg parasitoid of lepidopterous pests. J. Egypt.Ger. Soc. Zool. 34 (E) 1-5.)

D) News in 30 words:

If you have interesting short news or call for cooperation please write a 30-words-abstract.

E) Practical use of egg parasitoids: problems & suggestions

Please write about max. 40 words.

F) Data on the occurrence of egg parasitoid species in your country

that did not appear in previous issues of Egg arasitoid News, e.g.:

Country / reporter	species	native or imported (year / country)	reared (yes / no)	crops	host pest
USA, Hawaii R. Messing	***Fopius arisanus***	**imported (from Asia 1999)**	**yes**	**fruits**	**Ceratitis capitata**
