TEAM NEWSLETTER

TEPHRITID WORKERS OF EUROPE AFRICA AND THE MIDDLE EAST

No. 5 December 2007

TO OUR READERS

In a couple of weeks, an interesting experiment is acquiring substance. It is the first meeting of TEAM members and fruit fly workers of Europe, Africa and the Middle East and takes place in Majorca, Spain on the 7th and 8th of April 2008. The establishment and function of TEAM is indeed an interesting experiment mainly because it was based on the enthusiasm of a group of people -I call it a group of good friends- who shared common interests and suspense for bringing together fruit fly researchers in Europe, Africa and the Middle East. The seeds for the formation of this group were sowed approximately 10 years ago in a training course organized by the International Atomic Energy (IAEA) in Madeira, Portugal. I was among the participants of this training course together with Miguel Miranda, Yoav Gazit, Ana Carvalho and several other good friends. Our host was Rui Perreira and among our instructors were David Nestel, Walter Enkerlin and others. There were many of us who met again in 2000 in Iguaçu, Brazil, attending the XXI International Congress of Entomology. The first discussions for the establishment of a scientific, fruit fly group in the Mediterranean area were conducted during this meeting. After a "long evolutionary process" the idea was more formally shaped n Florida in 2004 during the 5th Meeting of the fruit fly workers of the Western Hemisphere. The group of fruit fly workers of the Western Hemisphere proved to be a good model for us. In that meeting, we had the opportunity to have inputs from other important fruit fly workers such as Slawomir Lux, Pedro Ros, Ana Alemany, Brian Barnes, Nikos Kouloussis, Mariangela Bonizonni, Giuliano Gasperi, Ana Malakrida, Serge Quilicy, Massimo Christofaro and others. The idea of forming a group in the Mediterranean region and neighboring areas was discussed with people from the Western Hemisphere group such as Pedro Rendon and with pioneers in fruit fly world such as Aris Economopoulos. The decision was made during those discussions. It took us a few more months of intensive e-mail exchanges to end up to the 2005 meeting in Vienna Austria, hosted by IAEA. IAEA and Jorge Hendichs personally had supported this initiative from the early beginning. They still provide important support to our current activities the first scientific meeting in Majorca included.

The establishment of TEAM is also an interesting experiment because of its independent function, the informality and the open registration and participation to all its activities. So far, the group functions at no cost but relies on the efforts and enthusiasm of its members. Decisions were made after intensive interactions through long electronic discussions. The driving force is our willingness to establish communication among the fruit fly scientists in Europe Africa and the Middle East, promote the basic research in fruit fly and strengthen the link between scientists and those who implement fruit fly management projects.

The first scientific meeting of TEAM in Majorca is the keystone of the group. Further to the scientific interactions, it gives us a unique opportunity to exchange ideas for the future of TEAM and make essential improvements in our effort to achieve our main goals. A day before the official opening of the meeting there is a meeting of the TEAM steering committee where several issues will be discussed. We hope to have interesting announcements to make after this meeting. Some of the issues include improvements in our web page and newsletter and the more intense involvement of our members to TEAM activities. Our plans go as far as establishing a fruit fly magazine. There might be more fresh ideas for improvements and further developments which all will be considered very seriously.

Andrew Jessup, a TEAM member, from Australia, recently moved to Vienna, Austria, accepting a position with the International Atomic Energy Agency. Andrew replaces Carlos Caceres, and his duties include fruit fly mass-rearing, quality control, mass rearing facilities management and other related activities. Andrew will be responsible for technology developments and research on the above tasks, and transfer to many countries implementing area wide fruit fly management. We would like to wish all the best to Andrew in his new position. Carlos after completing a very successful 7 years term with IAEA, returned to Guatemala accepting a position with USDA, leading a program on management of *Anastrepha* fruit flies. We would like to express our best wishes to Carlos for success in his new post.

Our current newsletter includes a very interesting paper by Pierre Duyck and Serge Quilicy on the interspecific competition and invasion ability of Tephritids in La Reunion. The fruit flies species of La Reunion comprise a very interesting model system for studying invasion and for predicting the outcome of species interactions in terms of dominance. There are

four species that share similar ecological requirements in La Reunion, an endemic one (*Ceratitis catoirii)* and three invasive (*C. capitata, C. rosa, Bactrocera zonata*). Pierre and Serge have explored this model system in an extensive and in-depth way providing general principles of invasion. In a series of studies they conclude that (i) the temporal sequence of establishment determine dominance with newly established species to be competitive dominant on previously established ones, (ii) both adult and egg size seems to be important determinants of competition at least for the exotic species, and (iii) the intrinsic rate of increase (r) decreases in successive invaders and the competition ability increases. Classifying invaders within the *r – k* continuum is not an easy task. The competition ability of a species is relative to local environment and to a resident community. The coexistence opportunities and the issue of reciprocal invasions are also discussed.

In this newsletter, the following are also included: a detailed program of the 1st TEAM meeting; a description of a pilot SIT project against the olive fruit fly in arid regions of Israel; and a new website for invasive fruit fly pests in Africa.

It is probably known to all fruit fly community that John Stonehouse, from Imperial College, a TEAM founding member and a good friend of many of us, passed away on September 26th 2007 in Senegal while working on a project. We were shocked to hear the news for the premature loss of John. This is a great loss for TEAM. We definitely miss John and his unique sense of humour. The TEAM steering committee and the newsletter editor express the deepest condolences to his family and relatives.

All TEAM steering committee members and myself are looking forward to meeting you in few weeks in our first meeting in Majorca. We hope this meeting to be the beginning of a series of exciting and interesting events for fruit fly workers in Europe, Africa and the Middle East.

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INTERSPECIFIC COMPETITION AND INVASION ABILITY IN TEPHRITIDAE: A CASE STUDY IN REUNION ISLAND

Biological invasions are considered to be a component of global change (Vitousek et al., 1996). As the eradication of exotic species is often impossible or expensive (Myers et al., 2000), the identification of potential invaders has become a major challenge. Numerous extrinsic causes favour invasions, such as the magnitude of propagule pressure (Lonsdale, 1999) or enemy release (Keane & Crawley, 2002). Interspecific competition with resident species has also been a major focus in invasion studies; detailed comparisons of traits of co-occurring native and invasive species are therefore useful for understanding and predicting invasions (Mack, 1996; Daehler, 2003).

By bringing together previously isolated taxa, bioinvasions have profound effects on both ecosystems function and communities structure (Williamson, 1996; Lounibos, 2002; Juliano & Lounibos, 2005). Although such consequences are often economically disastrous (Myers et al., 2000), they provide a unique opportunity to observe in real time the process of community assembly. Predicting how a community will be affected by invasions, based on the characteristics of invasive species and resident communities, is therefore a fundamental challenge as well as an important goal in conservation and pest management.

The family Tephritidae is well-known for multiple cases of invasions (Duyck et al., 2004a). Four species of ecologically very similar fruit-infesting tephritids now inhabit La Réunion, including an endemic species *Ceratitis catoirii* Guérin-Mèneville, and three other species that have successively invaded: *Ceratitis capitata* (Wiedemann) in 1939, *Ceratitis rosa* (Karsch) in 1955, and *Bactrocera zonata* (Saunders) in 1991. Each newly arrived species has partially excluded and/or displaced the species already present.

In the following text we summarize and discuss recent research conducted in La Réunion on this community of tephritids.

Competitive ability, traits and invasion ranks
Asymmetric and hierarchical interactions in both larval and adult interference competition have been demonstrated among these four species (Duyck et al., 2006a). In agreement with the hypothesis that invasion is competition-limited, the competitive hierarchy coincided with the temporal sequence of establishment on the island, i.e. each newly established species tended to be competitively dominant on previously established ones.

Based on comparisons between life-history data (Duyck et al., 2007) and competition data (Duyck et al., 2006a) we tried to identify traits associated with competitive ability. Among the three exotic invasive species, size seems to be a major determinant of competition. Egg size may influence larval competition: bigger eggs can reduce larval developmental times and thus confer a resource consumption advantage. This classical pre-emptive effect (Krijger *et al.*, 2001) was observed in the form of relationships between pupal mass and developmental time, both at the interspecific and intraspecific level: late-emerging pupae were smaller because faster-developing ones had already depleted the resource (Duyck et al., 2006a). Among the three invasive species, a larger adult size also seems to confer an advantage to females competing for ovipositional sites

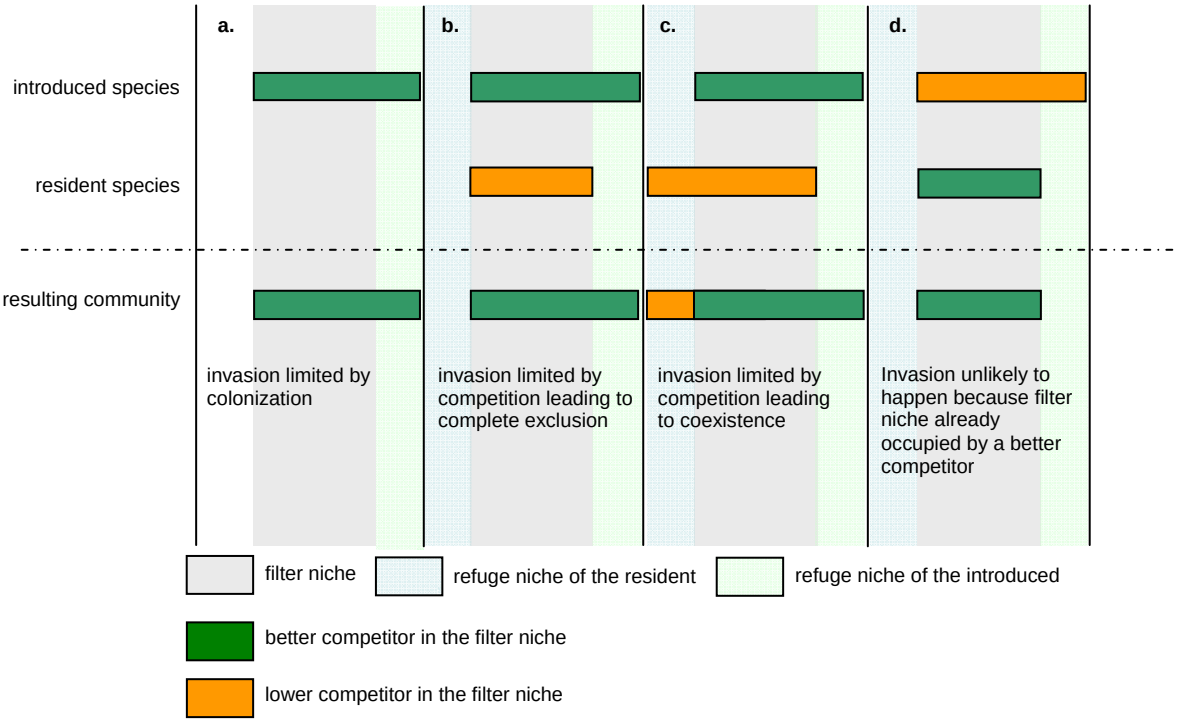

Figure 1. Different simplified cases of invasion and prediction of the resulting community according to the presence of a resident species, to the competition ability and to the niche width of this species. The "filter" niche corresponds to the habitat in which the introduced species need to establish a viable population (and thus resist to competition by the resident species) before spreading in other habitats. The "refuge" niche of a species X corresponds to habitats where it competitively dominates the other species (X>Y). **Case a:** no resident species, invasion requires only the ability to colonize in the filter niche. In the three other cases, in the presence of a resident, the introduced species must competitively dominate the resident in the filter niche to invade (invasion limited by competition). **Case b:** the resident species do not have refuge: it is excluded by the introduced. **Case c:** the resident species is displaced to its refuge niche. **Case d:** the introduced species could survive in its refuge niche but do not reach it because it is dominated by the resident in the filter niche.

in the same fruit, as pupal size ranks correspond to dominance ranks in interspecific contests among females (Duyck et al., 2006a). However, size is certainly not the only determinant of competition when considering the endemic species *C. catoirii*. This species lays large eggs, but is dominated by all others in larval competition, owing to a much higher larval mortality. Similarly, its large adult size is not associated to aggressive behavior in interference contests, during which this species is systematically displaced by all others (Duyck et al., 2006a).

The common hypothesis that successful invaders are often *r*-strategists (Lodge, 1993; Rejmanek & Richardson, 1996) is based on the assumption that competition is not a limiting factor for invasion. However, with the worldwide increase in the frequency of invasions, the probability for related taxa to be introduced successively in the same area increases (Mack et al., 2000; Mooney & Cleland, 2001). In this case, invasion may ultimately depend on the ability to outcompete, or at least to resist competition exerted by, resident species. In line with this hypothesis, in our system, as a result of trade-offs, the intrinsic rate of increase (*r*) decreases in successive invaders, while competition ability increases.

More generally, the competition ability of a species is always relative to a local environment and to a resident community. As a consequence, it might be vain to search for attributes common to primary (in the absence of related resident species) and secondary (in the presence of related resident species) invasions (Facon et al., 2006). Similarly, for secondary invasions, the absolute values of the invader's biological traits might be less relevant than the differences between invader and residents. In addition, we do not consider that our ideas are in contradiction with meta-analyses concluding invaders as *r*-strategists (Rejmanek & Richardson, 1996). Indeed invaders can well be at the same time *r*-strategists in comparison to non-invasive species, especially in cases of primary invasion (where colonization ability may be the most limiting factor, Figure 1a), and *K*-strategists in comparison to related species of the recipient community, when they are present (secondary invasions, Figure 1b).

Coexistence opportunities

The review of cases of invasions by polyphagous Tephritidae show that species are displaced along geographic (decrease of the distribution area) or ecological (niche shift) axes (Duyck et al., 2004a). The

study of the influence of climatic factors on the development of Tephritidae from La Réunion showed that the four species have overlapping fundamental niches (Duyck & Quilici, 2002; Duyck et al., 2004b; Duyck et al., 2006b), and all pairs of species are present in syntopy; therefore competition can take place in the field. However, in some pairs, the two species have different developmental optima and a climatic niche differentiation can take place among some species (Duyck *et al.*, 2006b). Thus, *C. rosa* can coexist with both *C. capitata* and *B. zonata* at a regional scale, while climatic niches are not different enough to promote coexistence of the latter two species. The endemic species has no private climatic niche either and this now very rare species could well be in the process of extinction.

The study of climatic niches of the four tephritid species confirms and extends the observation made on mosquitoes by Juliano (2002), that climatic factors can promote coexistence following an invasion (Figure 1c) and, more largely, determine the effect of invaders on the community (Juliano & Lounibos, 2005). Strong climatic contrasts are common in recent volcanic islands such as La Réunion where high mountains provide altitude gradients and rainfall markedly differs between mountainsides sheltered from ("lee-ward side") or exposed to ("wind-ward side") dominant winds. This, together with the pre-existent genetic diversity among species in response to temperature and humidity, may be one of the reasons why island species richness often increases following invasions (Sax *et al.*, 2002).

Analyses of an extensive field data series suggest that the four fly species largely overlap in fruit exploitation, once climatic effects are accounted for (Duyck et al., 2008). However, one species (*Ceratitis capitata*) can exploit rare fruit species that are not exploited by the other species present in the same climatic niche. The endemic species *C. catoirii*, now nearly extinct in La Reunion, has no private niche with respect to either climatic range or fruit use. On the whole, with the possible exception of *C. capitata*, the results point to a limited role of fruit diversity in encouraging coexistence among polyphagous tephritids recently brought into contact by accidental introductions (Duyck et al., 2008; Quilici & Jeuffrault, 2001).

Why reciprocal invasions are not observed?

If some species can dominate outside the main niche, why are certain reciprocal invasions not observed? To a certain extent it is even surprising that competitive abilities measured in an environment chosen to be nutrient-rich (guava) and thermally optimal (25°C) for all species adequately predict the invasion sequence. Why couldn't a species directly invade specific environments where it can be dominant, irrespective of its competitive ability in optimal conditions? We suggest that in the case of tephritids in La Réunion, and possibly in many other invasion cases, the propagule pressure is concentrated on a particular habitat. In La Réunion this habitat consists of anthropized, cultivated lowlands (a rich and warm niche relatively similar to our experimental conditions). This habitat may act as a "filter niche", in which any candidate invader must be able to establish a viable population (and therefore to resist competition by residents) before spreading to other habitats (Figure 1c,d). Further studies are however needed to test this hypothesis.

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PROGRAM OF FIRST MEETING OF TEAM

April 7, 2008

8:45-9:00: **Welcoming Words:** Miguel Miranda and Nikos Papadopoulos

9:00-11:00: **Symposium Session**: Fruit Flies' Associated Microflora
Organizers: Kostas Bourtzis and Antonio Belcari

- Wolbachia symbiosis in Tephritids (presented by Kostas Bourtzis)
- Genome dynamics of Wolbachia in *Rhagoletis cerasi* (presented by Christian Stauffer)
- Bacteria-Medfly interactions (presented by Boaz Yuval)
- What bacterial species constitute the symbiotic flora of the olive fly, *Bactrocera oleae*? (presented by Ilias Kounatidis)
- Bacteria-olive Fly interactions (presented by Antonio Belcari)

11:00-11:30: COFFEE BREAK

11:30-13:30: **Symposium Session**: Demography, Population Genetics and Invasion Ecology
Organizers: Nikos Papadopoulos and Giuliano Gasperi

- Globalization and fruitfly invasion and expansion: the medfly paradigm. A. R. Malacrida, L. M. Gomulski, M. Bonizzoni, S. Bertin, C. R. Guglielmino, G. Gasperi
- *Bactrocera oleae*: a single large population in the Mediterranean basin?: information from genetics. M. D. Ochando – Gonzales, D. Segura & C. Callejas
- Analysis of the olive fly invasion in California, based on microsatellite markers. Antonios A Augustinos, Nikos E Zygouridis and Kostas D Mathiopoulos
- The demography of invasion: Tephritids of La Reunion, a unique model to study invasion and competition. Pierre Duyck and Serge Quilici
- Life history evolution of an invasive tephritid. A., Diamantidis, J. R., Carey, & N. T. Papadopoulos

Lunch

15:00-17:00: **Poster Session I**
Coordinator: Francesca Scolari

17:00-17:15: COFFEE BREAK

17:15-18:45: **Forum Session**: Biology, Ecology, Rearing, and Control of the Olive Fly: Synthesis
Coordinator: Arisitidis Economopoulos

17:15-18:45: **Forum Session**: Buffer Zones and Minimal Project Size in SIT Projects: Tropical vs. Mediterranean Landscapes
Coordinator: Yoav Gazit and Rafael Argiles Herrero

18:45-19:00: All you Wanted to Know About TEAM
Presenter: Abdeljelil Bakri

CULTURAL TOUR IN PALMA

April 8, 2008

9:00-11:00: **Symposium Session**: Current Trends in Biological Control of Fruit Flies.
Organizers: Serge Quilici and Francisco Beitia

- Interest of *Oecophylla longinoda* for mango fruit flies control in Benin. Vayssières J.F. and P. Van Mele
- Exploration for natural enemies of the invasive fruit fly *Bactrocera invadens* (Diptera: Tephritidae) in its aboriginal home of Sri Lanka. Billah, M.K., Ekesi, S. & R. Hanna
- Successful acclimatization of the ovo-pupal parasitoid *Fopius arisanus* in Reunion Island for the biological control of the Peach fruit fly, *Bactrocera zonata.* Quilici S., P. Rousse, J.P. Deguine, C. Simiand, A. Franck, F. Gourdon, T. Mangine and E.J. Harris
- Host preference and performance of two introduced opiine parasitoids, *Fopius arisanus* (Sonan) and *Diachasmimorpha longicaudata* (Hymenoptera: Braconidae) against *Bactrocera invadens* and five indigenous fruit fly species. Mohamed, S.A., Ekesi, S. & R. Hanna

11:00-11:30: COFFEE BREAK

11:30-13:30: **Symposium Session**: Landscape Ecology of Fruit Flies in Africa, Europe and the Middle East
Organizers: Abdeljelil Bakri and Ana Alemany Ferra

- Environmental and management determinants of olive fly (*Bactrocera oleae*) spatio-temporal patterns, Ilias Kounatidis et al. (talk given by D. Nestel).
- Status of Medfly in Tunisia, Meriem M'saad (Tunisia).

- "Species-specific factors affecting fruit fly field populations: a review with emphasis to host plants" Romana Rombe Bandeira (Mozambique).
- Developing an area-wide spatial decision support system (SDSS) for Medfly control in citrus in Israel, Yafit Cohen et al.

Lunch

15:00-17:00: Poster Session II
Coordinator: Francesca Scolari

17:00-17:15: COFFEE BREAK

17:15-18:45: **Forum Session**: Trapping Fruit Flies
Coordinator: Nikos Kouloussis

17:15-18:45: **Forum Session**: Invading *Bactrocera*: *B. invadens*, *B. zonata*, *B. latirifrons* and *B. cuccurbitae.* **Coordinator:** Sunday Ekesi and R. Hanna

18:45-19:15: Meeting Conclusion and Closing Remarks
Coordination: Organizing Committee

CLOSURE DINNER AND CULTURAL PROGRAM

TEAM NEWS: FEASIBILITY STUDY ON THE APPLICATION OF OLIVE FLY SIT IN ARID REGIONS OF ISRAEL

During the last year, the Agricultural Research Organization of Israel (ARO) in conjunction with the Plant Protection and Inspection Services of Israel (PPIS), the Land Authority of Israel (KKL) and the International Atomic Energy Agency (IAEA) launched a pilot project to inquire on the possibility of using SIT for the control of the olive fly in desert areas. The project is supported by a Technical Agreement between the IAEA Technical Co-operation Department and the Ministry of Agriculture of Israel, and by funds of the Chief Scientist Fund of the Ministry of Agriculture, Israel. The project is coordinated by David Nestel of the ARO. The launching of this project was based on the premises that olive fly can be controlled using SIT in desert areas, where olive cultivation is undertaken in “production islands” separated by large gaps (several kilometers) of desert shrubs. It is expected that under these conditions, sterile flies will be able to reduce the population of wild flies, and damage. Since the “olive production islands” of southern Israel are relatively small (several hectares per production patch), we expect that constant releases of sterile olive flies may be able to keep “in-check” the wild olive fly populations of the desert orchards. During 2007 we initiated the project by constructing a hybrid line using laboratory material from the Crete line and wild flies from Israel. This was conducted in the IAEA laboratories at Seibersdorf, Austria, with the assistance of Dr. Carlos Caceres and other colleagues. This hybrid line is now under stable colony production in Seibersdorf. Recently, we conducted a mating compatibility and competitiveness study to investigate the compatibility of the sterile hybrid laboratory line and the Israeli wild fly. The study was conducted during November 2007 in Beit-Dagan, Israel by Polychronis Reboulakis from the University of Crete at Heraklion and David Nestel. We were advised by Prof. A. Economopoulos from the University of Crete. The results showed a very good compatibility between the two strains and acceptable levels of competitiveness of the hybrid sterile fly. We are currently monitoring wild olive fly populations in an olive production island selected for the pilot project. Recently, the project was visited by Dr. Nikos Papadopoulos, from the University of Thessaly, who helped establish the guidelines for the pre and post release monitoring systems. We expect in the next years to start releasing sterile flies in the pilot orchard, and study the ability of the SIT approach to control olive fly damage in these extreme environments.

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NEW WEBSITE ON INVASIVE FRUIT FLY PESTS IN AFRICA

Fruit flies (Diptera, Tephritidae) are considered an insect group of major economic significance. Several representatives are known to attack different types of commercial and wild fruits and vegetables, causing considerable damage to agricultural crops. The African fauna comprises almost 1000 described species. More than 50 of them are of economic significance. Although most of these are species native to the African mainland or to any of the Indian Ocean islands, some were accidentally introduced from other regions, in particular from Asia. So far, four Asian species belonging to the genus *Bactrocera* invaded Africa, two of which in recent years. These accidental introductions greatly aggravate the pest problems encountered by farmers in African countries, and result in great losses both in local sales and in export potential. There is, therefore, an urgent need for considerable strengthening of the human and physical quarantine and monitoring infrastructures in Africa, in order to avoid any further unwanted introductions.
With financial assistance of the International Atomic Energy Agency, researchers of the Royal Museum for

Central Africa (Tervuren, Belgium), the Plant Protection Research Institute (Dokki, Egypt) and the Natural History Museum (London, UK) have compiled a website with relevant information. This website aims to provide a diagnostic tool for the identification of the Asian introductions already established in Africa. Rather than using the traditional system of diagnostic identification keys, the site takes a more user-friendly approach with several questions and images in order to allow the non-specialist user to narrow down to the actual species. The site also provides information on the host plant range (both in Africa and elsewhere) and distribution, and references to studies on their biology either in their native range or outside.
URL of the website:
http://www.africamuseum.be/fruitfly/AfroAsia.htm

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FORTHCOMING MEETINGS

1st Meeting of Tephritid Workers of Europe Africa and the Middle East, 7 – 8 April 2008, Majorca, Spain. For more information email *ma.miranda@uib.es* or *nestel@agri.gov.il*

XXIII International Congress of Entomology, 6-12 July 2008, Durban, South Africa. For more information visit *http://www.ice2008.org.za/default.asp*

IOBC/WPRS Working Group "Integrated Plant Protection in Fruit Crops", 7th International conference on Integrated Fruit Production, Avignon, France. 27-30 October 2008. For more information email *benoit.sauphanor@avignon.inra.fr* or download *First announcement with pre-registration form*

THIS NEWSLETTER

This newsletter is intended for the publication of subjects of interest to the members of TEAM. All content is solicited from the membership and should be addressed to:

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Our Cartoon

(By David Nestel)