I welcome you to the first newsletter of our group. The year of 2005 has been an important one for the Tephritid Workers of Europe Africa and the Middle East (TEAM). During the organizational meeting, held on the 11th of May 2005 in Vienna, approximately 60 participants, of more than 30 Institutions in 25 countries, decided to establish TEAM as an independent professional, scientific organization. Since that meeting, the list of TEAM members has been growing, and it currently numbers more than one hundred people.

TEAM consists an independent, professional, scientific organization that intends to (a) provide a platform of interaction that will promote collaboration and communication among scientists of Europe, Africa and the Middle East, (b) pursue and stimulate the generation of basic and applied research to solve agricultural and trade problems related to fruit flies in these regions, (c) serve as a consulting forum to State Agencies on topics related to the noxious effect of fruit flies, (d) act as a link between other world organizations dealing with fruit flies in order to generate joint activities, (e) serve to bring the general public closer to the scientific and technical community working with fruit flies.

There are many challenges we face in the beginning of TEAM’s life. One of them is the development and regular publication of our Newsletter. We plan to issue the Newsletter twice a year in June and December. As it will become developed, the Newsletter will mainly include invited papers, commenting on recently published papers on fruit flies, news from TEAM members, information about scholarships and funding opportunities, announcements, and perhaps a list of recent papers by TEAM members. The newsletter will be distributed electronically in PDF format via e-mail, and will be also posted in the TEAM web site that is currently under construction.

The development of this web site consists another challenge for our group. Thanks to the efforts of Abdeljelil Bakri and his colleagues, a web page will be up by February. This web page will serve as an online platform of interaction between our members that will hopefully promote collaboration and intensify fruit fly research in Europe, Africa and the Middle East.

Information regarding the professional activities of our members will be available online; new achievements and recent papers will be highlighted as well.

Another big goal is the establishment of a regular scientific meeting in which tephritid workers will be able to report their work and discuss basic and applied scientific advances, agricultural applications and trade regulations and problems. The steering committee of TEAM has recently decided to organize the first scientific meeting in autumn 2007, in Majorca Spain. The end of October or the beginning of November 2007 looks as the most convenient season. We will try to keep participation cost at minimum intending to bring to this meeting as many young students as possible. An effort will be done to raise money in order to support participation from developing countries. The main theme of this first meeting will be the review of recent advances in the ecology of fruit flies in Europe Africa and the Middle East. Future meetings will cover specific topics in fruit fly research of broad interest within the above regions.

The success of TEAM and the achievement of it's goals depend on the contribution from all the members. So please contribute and feel free to make novel suggestions. TEAM is open to new ideas because new ideas will definitely promote our objectives. Regarding our Newsletter, we would like to include in it fresh news and updates from all three areas of TEAM. So, please send us your news and any information that you consider worthy to be included in our next Newsletter. Finally, let's all of us encourage new members to join our group, particularly graduate and Ph.D. students who will bring enthusiasm and vital energy.

On behalf of all members of the steering committee of TEAM, I wish you a happy 2006 full of professional and personal achievements.

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In many fruit growing regions worldwide, the Sterile Insect Technique (SIT) is rapidly becoming the primary control tactic used against fruit flies. The success of this approach hinges on releasing sexually competitive males into the target population. Such males must be able to disperse and survive in the wild, attract, copulate and inseminate wild females. Furthermore, they should be able to render the females they mate with refractory to further copulations. Accordingly, identifying and understanding the factors that contribute to male reproductive success in tephritid flies have, in addition to their basic fascination, important applied implications. In this paper I briefly identify the hurdles or obstacles a male must overcome in order to realize his reproductive success. I will then focus on the challenges facing the male during the final stages of the sexual encounter – the transfer, storage and utilization of his sperm.

In order to realize their potential reproductive success, male animals must successfully accomplish three successive yet discrete tasks. They must copulate with a female, transfer sperm to their mate, and have their sperm used in fertilization of her ovae. Success in overcoming each one of these hurdles – whose difficulty may be determined by competition from other males or by female choice – is necessary for proceeding to the next step, but does not guarantee final success. For male Mediterranean fruit flies, and many other tephritid flies, the initial stages of this metaphoric hurdle race are: joining or establishing a lek, producing courtship signals, copulating with a female attracted to those signals, and transferring a substantial ejaculate (Yuval and Hendrichs 2000). Following disengagement from the female the males ejaculate is left to fend for itself within the female reproductive tract, where it must be stored and later used for fertilization.

Before enlarging on what happens to the ejaculate, I will describe the environment it now must face, the female genital tract. From the female perspective, the ejaculate can, generically, be seen as a necessary evil, because it may contain substances that are harmful to females and act to restrict their receptivity to further copulations (e.g., Chapman et al., 1995). At the same time, male gametes represent a vital reproductive resource, upon which fertilization hinges. Accordingly, in order to deal efficiently and safely with this resource, the female reproductive tract of many animals - from lowly annelids to advanced insects and even vertebrates - has evolved specialized storage organs. These organs may be found at increasing levels of complexity and sophistication. A single sperm storage organ allows females to temporarily separate insemination from fertilization. Maintaining multiple organs (i.e., 2 or 3 spermatiche, as found in many flies) allows polyandrous females to divert and segregate the ejaculate to a particular location and to bias paternity by selectively mobilizing sperm from a particular storage organ (reviews by Eberhard 1996; Simmons 2001). In many species of acalyptrate flies 1-3 spermatiche coexist with, or have been superceded by, an evolutionarily novel sperm storage organ -- the ventral receptacle. In the Tephritidae, the female genital tract contains spermatiche (2 in most species, 3 in species of the genus Anastrepha), and a ventral receptacle (synonymously known as the "fertilization chamber") (Figure 1). A number of elegant ultra-structural studies on several tephritid species have established that the fertilization chamber is a cuticular extension of the ventral wall of the uterus, consisting of approximately 80-100 ovoid or spherical alveoli, surrounding a lumen. Each alveolus can harbor several coiled spermia (Solinas and Nuzzaci, 1984; De Carlo et al., 1991; Marchini et al., 2001; Fritz and Turner, 2002).

Furthermore, Marchini et al., (2001) showed that mature eggs are shunted into the fertilization chamber prior to oviposition, with the microprole bearing end facing the alveoli, strongly suggesting that fertilization indeed occurs at this site. This finding was recently reinforced by the demonstration that females whose spermatiche were surgically removed, continued to lay fertile eggs for as long as 10 days after surgery (Twig and Yuval, 2005). Indeed, both types of storage organs are able to maintain sperm viability. Structural studies of the spermatiche and fertilization chamber show that each have several types glandular cells that discharge into the sperm holding areas (e.g., Fritz and Turner, 2002; Marchini et al., 2001), and vital staining of sperm from both organs demonstrated high survivability of sperm in both organs (Twig and Yuval, 2005).

Male genital morphology and insemination capabilities may have evolved in sequence to the sperm storage abilities of females. Eberhard and Pereira (1995) and Marchini et al., (2001), unraveled the mechanics of copulation and insemination in the medfly. The latter study found that when the adeagus is fully inserted, two gonopores on the distiphallus discharge into the insemination pocket which leads into the spermatiche ducts. At the same time another gonopore, on a projection called the genital rod located slightly below the distiphallus and facing in the opposite direction, discharges sperm into the fertilization chamber.

On the days following copulation, sperm gradually disappear from both spermatiche, in a nearly linear fashion. Thus, sperm numbers decline from about 3,500 on the day of copulation to about 650 (give or take a few), 18 days later (Twig and Yuval 2005). Conversely, a different pattern of sperm dynamics is evident in the fertilization chamber. In this organ, a more or less constant number of sperm (around 200) is maintained throughout the same time period. These findings led us to conclude that both spermatiche and the fertilization chamber are active sperm storage organs, with separate functions, the spermatiche for long term storage and the fertilization chamber, periodically filled by the spermatiche, a staging point for fertilizing sperm (Twig and Yuval 2005).
Patterns of the distribution of sperm between the female’s two spermathecae were looked at in a number of studies (Yuval et al., 1996; Taylor et al., 2000, and references therein). In each study, there was a significant tendency for sperm storage to be biased toward one spermatheca. This storage asymmetry may be relevant to post copulatory decisions of offspring paternity. By biasing sperm to one organ, females may then be able to fill the other with sperm from another male. There is good evidence that some other flies are indeed able to do this, which of course hinges on the tendency of females to mate multiply (Simmons, 2001).

Indeed, a growing body of evidence suggests that medfly females do remate quite frequently, both in the laboratory (reviewed by Mossinson and Yuval 2003) and in the field (Bonizzoni et al., 2001; Kraaijeveld et al., 2005). While mating with more than one male has obvious genetic benefits, due to increasing the genetic variability of a female’s offspring, it also has costs. These consist of the energy and time spent sampling males, and considerable risk from predators that home in on sexually active males (Hendrichs and Hendrichs 1998). Thus, the optimal female strategy may be to mate multiply, but not too often. To do so she must choose her first mate judiciously and husband his sperm economically. This strategy may initially seem at odds with the strategy of the male, whose primary interest is to fertilize all of the females ovae, and prevent her from remating. We still do not completely understand how female receptivity is regulated in the medfly. However, there is strong evidence that, in addition to the males precopulatory performance (Blay and Yuval, 1997; Shelly et al., 2004), sperm and male accessory gland substances modulate female behavior (Jang 2002; Miyatake et al., 1999; Mossinson and Yuval 2003). Thus, in order to postpone his mates next copulation for as long as possible a male must transfer, and the female must store, a substantial ejaculate. The complex sperm storage organs and the peculiar insemination abilities of the male described above may have evolved in order to achieve these goals. Females can practice sperm husbandry by moving sperm from spermathecae to fertilization chamber, where fertilization is efficiently consummated. This may represent a confluence of male and female interests, rather than a conflict between the sexes, because, assuming the first mate is a high quality male that transfers a large ejaculate, postponing copulation benefits both partners. The first male gains fertilizations, and the female is spared the cost and risk of finding another mate. Future research should elaborate precisely how female sexual receptivity is modulated, and determine the patterns and mechanisms governing sperm storage and use when more than one male has inseminated the female.

Finally, these mechanisms are highly relevant to the SIT. Mass reared sterile males transfer a significantly smaller ejaculate to females (Taylor et al., 2001), and these females remate at higher rates than those mated to fertile males (Mossinson and Yuval, 2003: Kraaijeveld and Chapman 2005). We need to determine if females handle the ejaculate of sterile males differently from fertile males, and why. Furthermore, quality control procedures should routinely include a measure of male sperm load and ejaculate composition. In the future, we may learn how to enhance the biochemical properties of the ejaculate and the insemination ability of sterile males to make the SIT more effective.

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References cited:


SIT FOR AFRICA

The increasing importance of quarantine pests in international fruit trade, the mounting demand from international clients for healthy fruit produced under ecologically compatible conditions, and a diminishing arsenal of acceptable chemical products for their control has provided the impetus for the implementation and expansion of the sterile insect technique against fruit flies in South Africa. SIT addresses all of these factors and is increasingly regarded by fruit growers as essential for survival on the international market.

Eight years ago a pilot project to investigate the viability of SIT for control of Mediterranean fruit fly (Ceratitis capitata) was initiated at ARC Infruitec-Nietvoorbij in Stellenbosch, in collaboration with the International Atomic Energy Agency (IAEA) in Vienna. Dr Brian Barnes and David Eyles of the Pest Management Division managed the pilot project, with sterile Medflies being produced in a mass-rearing facility funded by a formal Partnership between the Agricultural Research Council and the Deciduous Fruit Producer's Trust.

After weekly releases of sterile Medflies in the 10,000 ha Hex River Valley SIT project started in 1999, numbers of wild flies trapped were between three and 16 times lower than before SIT. Before SIT, fruit fly control costs in the Valley were about US$500,000 per annum. SIT project costs with aerial releases of sterile flies were about US$180,000 per annum, thus a saving of more than 60%. Initially, twice-weekly releases of sterile flies were made by air. However, without government funding for the programme aerial releases proved too expensive, so in 2002 the strategy was changed to ground releases concentrating on backyards and other fruit fly hotspots. Sterile Medflies have since then also been routinely released in the Elgin and Villiersdorp areas and in the Riebeek Valley area, protecting an additional 15,000 ha of deciduous fruit and table grapes. Three other production areas, including one across the border in Namibia, have expressed an interest in fruit fly SIT.

Since July 2003 all fruit fly SIT rearing and release activities are now carried out by a private company, SIT Africa (Pty) Ltd, the first private fruit fly SIT company in the world. The company sells sterile Medflies to the growers that are contracted into the programme, and where necessary contracts in technical expertise on SIT from the Pest Management Division at ARC Infruitec-Nietvoorbij. Each production area has an SIT Coordinator and supporting field staff. At present approximately 6 million sterile male Medflies are produced per week for the weekly ground releases in the various SIT areas. The estimated maximum output of the current rearing facility is 10 to 12 million sterile males per week. However, expansion of SIT to a wider local market is dependent on the cost of the sterile flies being more competitive.
Besides a lack of adequate funding, one of the major constraints to greater success with the SIT programme has been the failure by growers to properly manage alternate fruit fly host plants in the release areas. These include table grape bunches left on the vines after harvest, unsprayed fruit trees in backyards, and many, many wild fruit fly host plants bearing fruits of some description that are unsprayed or left on the plants.

In November 2005 the South African Government, through the National Department of Agriculture, has pledged financial support for the Medfly SIT programme with a proposed R4 million (US$615,000) grant. This signals a major change in the Government's stance on SIT, and is the first central government funding for the programme. It is hoped that this will become an annual grant, and it will go a long way towards widening the use of SIT in the deciduous fruit industry. Another significant financial boost is expected to come through the introduction of a dedicated, statutory SIT levy on fruit growers, which will widen the funding base of the fruit fly SIT programme.

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BIOLOGICAL CONTROL OF FRUIT FLIES IN REUNION ISLAND

At the end of 2003, a strain of the ovo-pupal parasitoid Fopius arisanus, was imported from Hawaii to Reunion, in a collaborative project between CIRAD Réunion and USDA Hawaii (E.J. Harris). A small-scale rearing of the parasitoid was developed on Bactrocera zonata, and inoculative releases were made during 2004 in various sites of the island, with a total of 43000 parasitoids released. Surveys conducted in 2005, revealed the presence of the parasitoids in different sites, and its acclimatization can be considered to be effective. For next year, the stress will be put on the evaluation of the geographical distribution of F. arisanus and of its impact on the natural fruit fly populations. In the meantime, laboratory studies have been conducted on the biology, specificity and behaviour of this species.

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EUROPEAN PHD CURRICULUM

European PhD curriculum in "Insect Science & Biotechnology". This program was developed by an International Consortium, including the Imperial College London (UK), the University of Newcastle upon Tyne (UK), the Universität Bayreuth (Germany), the Université F. Rabelais de Tours (France) and a net of Italian universities (University of Basilicata, Università degli Studi dell’Insubria, Università degli Studi di Milano, Università degli Studi di Napoli, Università degli Studi di Pavia, Università degli Studi di Perugia, Università degli Studi di Siena, Istituto di Biochimica delle Proteine, C.N.R., Napoli, Istituto di Genetica e Biofisica, C.N.R., Napoli). The basic idea is to provide a comprehensive educational and research background in the field of insect biotechnology by bringing together scientists that are experts in insect sciences and those having a molecular and biotechnological background. The duration of the PhD Course on "Insect Biotechnology" is 3 years. For more details: www.europhd-insectbiotechnology.net/status.htm.

PHD CELLULAR BIOLOGY

It is a three-year program offered by the Italian University of Pavia. It is open to a wide range of research areas as different as insect molecular biology, ecology and animal behavior, developmental biology, parasitology, cellular biology. The program is in Italian, but open to non-Italian citizens. For more information, see: www.unipv.it/webbio/welcall.htm and/or contact professor Giuliano Gasperi at gasperi@unipv.it.

JOB OPPORTUNITY

National & International Research & Development Manager: INSECT SCIENCE, a leading company in Pheromone based products in the International and National Market, have an exciting opportunity for a young Entomologist to implement and apply research and discover and develop new solutions for pest control strategies in the Agricultural, Horticulture, Forestry and Industrial markets. Seeking an individual with a MSC in entomology with two to five years of experience. Applicant has to be innovative, methodical, and practical, be a good team player and be able to read people well. Candidates with experience in the registration of products in terms of Act 36 of 1947 will be advantageous. Candidate has to relocate to Tzaneen, Limpopo Province. Email or fax your resume to Renaldo Aucamp (Financial Director) at renaldo@insectscience.co.za or Fax +27 15 307 6555. For more information about the company visit www.insectscience.co.za

FORTHCOMING MEETINGS

Seventh International Symposium on Fruit Flies of Economic Importance and Sixth Meeting of the Working Group on Fruit Flies of the Western Hemisphere, 10-15 September 2006, Salvador, Bahia, Brazil.

First Meeting of Tephritid Workers of Europe Africa and the Middle East, Autumn 2007, Majorca, Spain.

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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