

## Fruit Flies in the Mediterranean and Arab World: How Serious a Threat are they and How Can we Minimize their Impact

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### Abstract

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Tephritid Fruit flies are found distributed throughout the Mediterranean and Arab world and cause considerable economic damage to fruit and vegetable crops. With increasing emphasis on quality of fruit and vegetable produce and with the expansion of trade in horticultural commodities, the importance of good fly management policies is vital. Phytosanitary measures and quarantine checks are increasingly necessary to prevent transport to areas free of the infestation. It is fortunate that there are a range of effective control measures that can be employed alone and/or in combination and new techniques are being sought. Cooperation across countries/region is also increasingly essential to combat the threat of fruit flies.

**Keywords:** Fruit flies management, phytosanitary measures

### Background

Tephritid fruit flies (Diptera: Tephritidae) are among the most destructive agricultural pests in the world. There are nearly 5,000 described species of tephritid fruit fly, categorized in almost 500 genera, of which about 70 species are considered economically important. The genus *Bactrocera* and *Ceratitis* have a world-wide reputation for its destructive impact on agriculture. Larvae feed on the pulp of the fruit, making it soft and unfit for human consumption. The fruit crops attacked, include citrus, mango, guava, top and stone-fruit, as well as olives, vegetable crops and many others.

In the Arab countries fruit flies have become a severe a regional problem, with many fruit flies of economic importance. The most notable are the Mediterranean fruit fly (*Ceratitis capitata* (Wiedemann)), olive fruit fly (*Bactrocera oleae* (Gmelin)) and peach fruit fly (*B. zonata* (Saund)). Other fruit flies include the Oriental *B. dorsalis* and Melon fruit fly *B. cucurbitae* which also have a wide distribution but of lower economic importance.

The Mediterranean fruit fly has the widest host range of any pest fruit fly, and is ranked first among economically important fruit fly species worldwide and in the Arab countries. It has been recorded infesting over 300 cultivated and wild fruits. The larvae feed upon the pulp of host fruits, sometimes tunneling through it and eventually reducing the whole to a juicy, inedible mass. In some of the Mediterranean countries, only the earlier varieties of citrus are grown, because the flies develop so rapidly that late season fruits are too heavily infested to be marketable. Some areas have had almost 100% infestation in stone fruits. Harvesting before complete maturity is now commonly practiced in Mediterranean areas infested with this fruit fly.

Once the medfly is established, eradication efforts may be extremely difficult and expensive. In addition to reduction of crop yield, infested areas have the additional expense of control measures and costly sorting processes

for both fresh and processed fruit and vegetables. Some countries maintain quarantines against the medfly, which could jeopardize some fresh fruit markets if it should become established.

Estimates of damage for the med fly vary, but a good example of the severity is in the Mediterranean Basin countries. If no control measures are applied against *C. capitata*, the annual fruit losses are estimated to be about U.S. \$365 million (2). Under the current control programs, the direct damage (yield loss and control costs) and indirect damage (environmental impact and loss of export markets) amounts to U.S. \$192 million per year. Add to this the cost of constructing and maintaining fruit treatment and any eradication facilities, the full scale of the detriment resulting from the Mediterranean fruit fly in this area is difficult to gauge.

In Tunisia med fly is a major problem for fruit production in Tunisia, and although data on exact losses are not readily available it can reach up above 50% if not treated. In Saudi Arabia, it is considered to be one of the most economical fruit pests (as in other Arab countries), where the presence of this pest causes a barrier to export, due to strict quarantine laws to prevent the spread to countries that are free of this pest. In Egypt, MOA stated that the general average of *C. capitata* infestation was found across a range of crop with the highest in Grape fruit 28.13%, Java 27.1%, Apricot 24.41% peach 23.22%, Fig 8.67%, Orange 7% and Mango 6%. It was also noticed that *C. capitata* is transmitting the fungus *Penicillium digitatum* and *P. italicum* through egg deposition which intensifies the number of fallen fruit.

There are many export farms in Egypt producing citrus, mainly orange and they need to spend significant resources to maintain citrus free of the med fly.

The recent problem in Iraq has led to the breakdown of agricultural quarantine which kept medfly at check. This has resulted in a serious outbreak of this fruit fly in citrus orchards, due mainly to illegal imports of different medfly hosts like citrus, stone-fruits and vegetables from Syria, Iran, Lebanon, Jordan and Turkey (1).

Olive fruit fly is widely distributed in the Mediterranean basin, Middle-East and North Africa and poses a severe economic threat for commercial olive growers. The larvae feed inside the fruit, destroying the pulp and allow the entry of secondary bacteria and fungi that rot the fruit and degrade the quality of the oil. Feeding damage can cause premature fruit drop and reduce fruit quality by increasing the acidity for both table olive and olive oil production. Olive cultivars show varying susceptibility to infestation by olive fruit fly, with larger size of olives and with a higher water content being the most vulnerable to *B. oleae*.

In areas where olive fruit fly is well established like in the Mediterranean region, it has been responsible for about 30% crop losses, especially in countries such as Greece, Italy, Spain and Tunisia where large commercial production occurs (3). If not treated it is capable of destroying 100% of table cultivars and up to 80% of oil value ([www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74112.html](http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74112.html), 2009). For table olive growers, the presence of even a few infested fruit can lead to rejection of an entire crop. The economic threshold for oil production depends on the country, but it is considered around 10% of the olive fruit being damaged by the fruit fly as long as the fruit are not rotten.

The peach fruit fly, *Bactrocera zonata* is considered one of the most destructive fruit fly pests and is found in northern Africa (Egypt and Libya) and from a number of countries on the Arabian Peninsula: Oman, Saudi Arabia; United Arab Emirates and Yemen. *B. zonata* is polyphagous, but its main hosts are ripe fruit of mango, guava and peach although it also attacks apricot, figs and citrus rendering them inedible. The symptoms are normally signs of oviposition punctures and a sugary liquid that exudes and solidifies adjacent to the entry point. Larvae feed on the flesh of the fruit, causing it to decompose.

In Pakistan, which neighbors the Arab Gulf region, fruit losses from fruit flies, at the farm level, are estimated to be \$200 million annually in fruits and vegetables (5). The majority of fruit damage is attributed to the infestation by the peach fruit fly attacking mango and guava; with added losses to traders, retailers and exporters. In Egypt, *B. zonata* has been recorded in several governorates in Egypt where it has caused immense problems to many fruits. An estimation of the economic impact is at 190 million EUR damage a year (4). A major concern is the risk to spread to other Mediterranean countries through trade pathways and passenger movement. To reduce this possibility a surveillance programme is needed to be effectively employed.

There are a range of control measures for fruit flies that are very dependant on the fruit fly spp. However, in principal these technologies available to combat this pest can be divided into several different categories.

## Chemical control

The use of cover insecticide sprays in the Arab countries, especially with organophosphate insecticides malathion or dimethoate against fruit flies has been practiced for many

years, and is still considered a very effective and relatively cheap control method for fruit fly. Pyrethroids have also been used for the same purpose. Some countries have also been using bait application of malathion and hydrolyzed proteins, which use lower quantities of the insecticide as they are applied as a spot treatment and are less damaging to the environment. However, organophosphates have been implicated in negative effects on natural enemies and human health. Malathion has come under considerable pressure in EU and USA and is either banned or restricted in many areas.

## New bait sprays

New more ecological sound bait sprays have been introduced, most notably the one from the Naturalyte class known as spinosad, now commercialized world wide and in several Mediterranean and Arab countries under different trade names.

This product is an ultra low volume multi species Tephritidae fruit fly food bait. It is available as a ready to use soluble bait concentrate and is highly efficacious, controlling both males and females flies, with only a very small amount of spinosad 0.24-0.36 gai/ha. It is applied as a spot treatment on every 3-4 trees at 7-14 day intervals (dependant on pest pressure). It is fully compatible with IPM, Sterile Insect Technique (SIT) and biological control strategies and is selective to bees. It also has received organic certification in USA, Europe and many other parts of the world and is replacing many of the chemical methods.

## Trapping

Detection with traps is the first line of defense against fruit flies and a critical element in programs to control them. There are 2 principal types of traps: those that induce flies to land and become trapped on sticky surface, and those that lure flies into an enclosed space where they drown in a liquid reservoir or contact an insecticide.

Examples of these types of traps:

- a) Yellow sticky traps where insects are attracted and simply get caught on the sticky material.
- b) McPhail Trap – A food attractant (protein hydrolysate or fruit juice) is used in this trap and it attracts both females and males mainly of *C. capitata*. After feeding on the solution, the flies are prevented from flying out of the trap – crashing against the walls and sinking in the solution
- c) The fruit fly lure is a Yellow delta trap that contains trimedlure to attract mainly males of *C. capitata*.
- d) There is also a Fruit Fly Bait Station that contains a Sensus trap (small bucket type trap) with protein hydrolysate and even a toxicant can be added, to attract Males and females of mainly *Ceratitidis* spp.

The Med fly trap is a new attract and kill system that contains the chitin biosynthesis inhibiting insecticide lufenuron in a gel formulation. It is designed to have a long lasting activity of 9 months, and utilizes a system of sexual

pheromone and food attractant aimed at attracting the Mediterranean fruit fly (*C. capitata*) males and females. The product is in development in several Arab countries and has shown to be very effective under light to moderate infestations.

### **Sterile insect technique (SIT)**

The sterile insect technique (SIT) is an environment-friendly method of pest control that incorporates well into integrated pest management programs. It is gaining an increasing role in the control of Mediterranean fruit fly, and has been demonstrated to be an effective method of control in Mediterranean countries: Spain, Italy, Tunisia, Cyprus, as well as in the Middle East where a project called Bio-Fly is being successfully spearheaded in Israel and Jordan. A considerable amount of the developmental work on this method of insect control has been sponsored by the UN International Atomic Energy Agency, IAEA.

SIT involves the release of large numbers of sterilized insects into the environment to mate with 'wild' insects of the same species, and any eggs laid are infertile, eventually controlling the fruit fly population. When fruit fly is detected in any one area, releases of sterile flies will be made twice a week for up to 12 weeks. Sterile insects have a short life span while fertile females may live for several months. That is why it is important to maintain high numbers of sterile flies in the outbreak area. It complements the use of bait sprays and cultural methods to further reduce the population.

### **Field sanitation**

This is a technique that either prevents fruit fly larvae from developing or removes young emerging flies so they cannot return to the crop to breed. There are a number of methods that can be employed such as: destroying infested fruit on the tree or the fallen fruit collected before and during harvest; bagging or deep-burying infested fruit; mulching or mowing the fallen fruit and even drowning larvae in the fruit. Intensive irrigation directly after harvest of the fruit can also be employed to kill pupae in the soil. Removing fruit before it ripens also reduces the larvae entering the soil to pupate. Also no fruit should be left on the tree after harvest.

### **Male Annihilation**

Male Annihilation Technique (MAT) involves the use of a high density of bait stations consisting of a male lures such as methyl eugenol, trimedlure, cuelure etc. to reduce the

male population of fruit flies to such a low level that mating does not occur. The lure traps are put out on a given area in numbers to catch the majority of males, thereby fertilizing fewer females. 'Attract and kill' systems combines the male lures and a toxicant usually technical malathion, dichlorvos and more recently fipronil and lambda cyhalothrin etc..., and is more effective in suppressing fruit fly males. MAT is normally used in combination with other fruit fly suppression techniques. In the Arab countries it has been slow to be adopted but could become a good tool in an IPM program or in an 'area-wide' suppression strategy.

New MAT technologies such as SPLAT™ (Specialized Pheromone & Lure Application Technology) are also being examined for fruit fly control. A good example is the SPLAT-MAT™ Spinosad ME, a new spinosad based formulation, ready to use sprayable Male Annihilation Technique (MAT) product that differs from current MAT products by eliminating the need for costly and labor intensive application of high density bait stations. It contains spinosad + Methyl Eugenol (ME), a powerful parapheromone for males in *Bactrocera* genus and results to date have been very encouraging.

### **Fruit Fly parasitoids**

The role of pupal parasitoids has been studied in some parts of the world for fruit fly control but is still very much in the early stages in the Arab countries. Some studies have been carried out to survey the seasonal abundance of the parasitoids as in the case in Egypt for the olive fruit fly, *B. oleae* and peach fruit fly, *B. zonata*. Using parasitoids is a useful tool to minimize infestation but never reaches 100% control because parasitoids are host density dependant

### **Conclusion**

Tephritid Fruit flies are found distributed throughout the Mediterranean and Arab world and cause considerable economic damage to fruit and vegetable crops. With increasing emphasis on quality of fruit and vegetable produce and with the expansion of trade in horticultural commodities, the importance of good fly management policies is vital. Phytosanitary measures and quarantine checks are increasingly necessary to prevent transport to areas free of the infestation.

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## المخلص

ليزاندر، مايك. 2009. ذباب الفاكهة في المنطقة العربية والمتوسطية: مدى إمكانية زيادة انتشارها وكيف يمكن الحد من أضرارها. مجلة وقاية النبات العربية، 27: 236-239.

بسبب الانتشار المتزايد لذباب الفاكهة على محاصيل الخضار والفاكهة في المنطقة العربية وبلدان البحر المتوسط خسارة اقتصادية مرتفعة على هذه المحاصيل. إن الاهتمام المتزايد بنوعية هذه المحاصيل للتصدير يجعل مكافحة ذباب الفاكهة بشكل متكامل خطوة مهمة وأساسية. بعد استخدام الطرائق الصحية والحجر الزراعي خطوات أساسية لمنع انتشار ذباب الفاكهة إلى المناطق الخالية منه. يجرى تجربة مجموعة من الطرائق التي تؤدي إلى مكافحة فعالة إما منفردة أو بالإضافة إلى طرائق جديدة تجعلنا نستبشر بتحقيق تقدم جيد في الحد من مخاطرها. كما أن التعاون الجاد بين بلدان المنطقة هو أساسي للوصول إلى نتائج حاسمة في مكافحة ذباب الفاكهة.

كلمات مفتاحية: الإجراءات الصحية النباتية، إدارة ذباب الفاكهة.

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