Science, Sex, Superflies

by Lothar Wedekind

A spin-off of nuclear science and technology has changed the dynamics of a complex mating game.

Along the way, it has spawned success stories—some small, some large—around the world during the IAEA's first half century.

They call the latest one *VIENNA 8 tsl,* designed to yield what an outsider might simply describe as a macho sex agent of science and technology. A veritable superfly bred for mating…and birth control.

VIENNA 8 tsl is a genetic sexing strain of *Ceratitis capitata,* the scientific name of the Mediterranean fruit fly, or Medfly. *Tsl* stands for "temperature sensitive lethal", which despite the connotation is a desirable mutation when it comes to mass-rearing and sterilizing Medflies in production centres. The trait coupled with a colour-coded genetic marker enables production of only the males, and that turns out to be a good thing.

Smaller than your little finger, the Mediterranean Fruit Fly—*Ceratitis capitata* in science speak—doesn't look like a roaming killer. But it is ranked among the world's most destructive food pests. A superfly of ruin.

Photo: USDA

The Medfly is on the most *unwanted* list of farmers and food inspectors in about 80 countries. If not controlled, the pest can nest in more than 300 fruit and vegetable crops — from Granny Smith to Beurre D'Anjou — and ravage them.

VIENNA 8 tsl is tailor-made to yield only male flies that stay strong enough after gamma sterilization to become virile agents of Medfly family planning. Once the sterile males are released into the wild, their mission is to compete in the mating game and win over willing females. The union is, of course, fruitless, and the outdoor fly population falls to nothing when systematically targeted over time. Biological birth control.

The genetic sexing strain is a 21st-century feature of the sterile insect technique (SIT). The technology has spawned success stories in unlikely places during the IAEA's first half century as the world's "atoms for peace" organization. What started out in the 1950s and 1960s on a small laboratory scale has peacefully "mushroomed" into a multi-million dollar affair that continues to attract more and more players.

VIENNA 8 tsl is among advances registered through the IAEA's joint work since 1964 with the Food and Agriculture Organization (FAO). At any given moment, more than four billion sterile insects—3.5 billion of them Medflies bred using genetic sexing strains—are being reared for weekly use at 30 SIT facilities worldwide. Among the latest are mass-rearing plants built in Bahia, Brazil, and Valencia, Spain.

All the SIT facilities supply pest eradication, suppression and prevention programmes against various insect pests. A main common goal: to protect the quality of food and agricultural products, including livestock, that the pests can attack and destroy.

Successes include winning battles from the Americas to Africa and the Middle East to Europe, Asia and Australia—against screwworm flies endangering cattle herds, tsetse flies killing livestock and humans, moths ruining crops and orchards, and fruit flies threatening entire harvests. Future applications target mosquitoes that transmit malaria and viral diseases, with research taking place through IAEA/FAO channels in Sudan and other countries.

In richer countries, the benefits of success are valued in tens of billions of dollars for fruit exporters, national economies, and public health authorities. In poorer countries, success means life for farming families reliant on their animals and crops.

"Fruit flies live in 178 countries and islands," Mr. Pablo Gómez Riera, an expert at Argentina's National Institute of Agricultural Technology, reports. Of these, he says, 20 species, including the Medfly, are the most harmful, triggering quarantine measures on food and agricultural products coming from infested areas. "That restricts their international trade significantly," he says.

Quarantines are lifted only after certification that products are grown and shipped from clean areas. "Newly adopted food safety and phytosanitary standards require the establishment of either low prevalence or entirely fruit-fly-free areas," he explains.

Male Medfly pupae, reared in the IAEA/FAO laboratory in Seibersdorf, Austria. Photo: Calma/IAEA

The Medfly has been eradicated from the continental United States, Mexico, and Chile, and effectively suppressed in many other countries — all with the help of the SIT in combination with other strategic area-wide measures.

In South Africa, for example, fruit fly suppression targets the Hex River Valley. Progress is impressive. "In one season, the number of cartons rejected for export because of fruit fly damage halved from 8% to 4%, the lowest it has ever been," says Brian Barnes, the scientist coordinating efforts.

Genetic sexing strains like *VIENNA 8 tsl* look to be the future for species-specific biological pest control. Other strains are in some stage of research and development, experts say, being designed to help combat various species of fruit flies and insects. At SIT rearing facilities, the production of only males is a step that saves considerable time and money.

"The latest genetic strain opens more doors for the SIT. It can become a part of routine Medfly suppression rather than only for big eradication or barrier programmes," explains Mr. Jorge Hendrichs, who heads the FAO/IAEA Insect Pest Control Sub-Programme. "That means no burdensome quarantines and less spraying of insecticides to meet requirements."

Though genetic research can be controversial, that has not been the case with the SIT so far. "Since the insects are sterile, they cannot become established in ecosystems, and carry no potential to adversely affect the environment," says Mr. Walther Enkerlin, an entomologist who works with Dr. Hendrichs. "The SIT is generally regarded as a 'clean and green' pest-control tool."

While the latest steps are welcome, there's still a good way to go, entomologists say. The future is tied even more closely to genetic research and development, and advances in other fields of science and technology.

"Sterilized males still don't perform as well sexually as their competitors in the wild," says Mr. Hendrichs, a recognized expert on Medfly mating and sexual behaviour. "That means to win in the wild, so many sterile males have to be produced and released that they far outnumber the competition." The FAO/IAEA last year launched a multinational Medfly research programme to learn more about the interplay between mass-rearing operations, radiation sterilization, and the performance of male fruit flies.

SIT advances complement other technologies at play.

In the United States, where invasive insects are on a hit list of transboundary threats, sterile male Medflies are being released in high-risk areas to prevent the pest's establishment. Scientists track the origin of Medfly outbreaks using genetic code. DNA samples have been collected from captured Medflies worldwide by Dr. Bruce McPheron and teams at Penn State University in the USA.

One of the last times the USA detected a Medfly outbreak in imported fruit, Dr. McPheron's team kicked in. They tapped genetic data on record that told them exactly where the pest had come from overseas. Food safety inspectors quickly moved to block the fruit sales — and to shut down the imports from the sending country.

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For more information, visit the IAEA.org website at www.iaea.org. Also see the Sterile Insect Technique, Principles and Practice in Area-Wide Integrated Pest Management, *the definitive book on the SIT edited by FAO/IAEA experts Arnold Dyck, Jorge Hendrichs, and Alan Robinson.*

Chile's leading edge

South America's top fruit exporter shows the way

Arica, Chile—In this famed city of "eternal spring", the sun shines long and rain is rare. Averaging less than a millimetre a year, precipitation tends to be remembered in drops per decade. In one stretch, no rain fell for 14 years.

Bordering Peru on Chile's northern Pacific shore, Arica is home to a quarter of a million people living along wide sandy shores and thin slices of green land in the Lluta and Azapa Valleys. Olives, vegetables, and varied fruits are grown there, fed by water pumped from deep below the ground.

Twice a week every week, Paula Troncoso-Kirsten oversees an air campaign to protect oasis crops from unnatural enemies. Hundreds of marked bags, each filled with 8000 sterile male Medfly pupae, are dropped systematically by airplane to rain on target zones in orchards, fields, and backyards.

The flies are factory-reared biological agents, sent as part of the area's pest prevention programme to mate with any female Medflies around. The males nearly always end up disappointed. Even if they did find a willing partner, the mating would end up being…well, fruitless.

"No Medflies naturally exist in this arid environment or anywhere in Chile," explains Ms. Troncoso-Kirsten. She heads the Arica Operations Centre of Chile's agricultural and livestock service, called SAG, and runs the region's Medfly prevention programme. Any Medflies found here are unwanted intruders that tourists or travellers bring in.

She leads teams that work closely with authorities in southern Peru, where Medfly pockets are known to exist, to contain the fly's movement. Peru runs its own Medfly control programme, and like Chile relies upon a method known as the sterile insect technique (SIT) that was developed with support of the IAEA and UN Food and Agriculture Organization (FAO).

The flies raining in Arica skies are homegrown at the nearby Sterile Insect Production Centre, Chile's only SIT facility, in Lluta Valley. The $2-million centre opened in 1993 with technical and financial support from the IAEA, United Nations Development Programme and Inter-American Development Bank.

Inside, teams of specialists rear about 35 million Medflies each week, using the latest methods. They produce a genetic sexing strain that enables rearing of only male flies. Chile's SIT plant supplies the weekly Arica air campaigns and those in Peru's Tacna region across the border.

IAEA-supported technical cooperation projects transferred the SIT technology to Peru, Chile and other countries over the past decades. Today, specialized training continues at IAEA research laboratories in Seibersdorf, Austria.

Chile's success in defeating the Medfly keeps lucrative export markets open to trade. At Valparaiso ports, fruit is bound for the USA. Photo: Wedekind/IAEA

"We're applying the latest technology for a programme that's very important to our national development," says Mr. Carlos Sarabia, the plant's manager. "The work we do here has benefited a great deal from IAEA and FAO expert support."

Chile is among the world's top fruit producers and exporters. No country in South America sells more fresh fruit and vegetables overseas, and Chile's earnings top $2 billion per year from their export.

"The success we've had against fruit flies is the driving force for our fruit and vegetable industry. It shows the value of international cooperation and our bi-national control efforts with Peru and collaboration with Argentina and other neighbours," says Mr. Jaime Gonzalez, an agricultural engineer and entomologist. Based in Santiago, he heads SAG's nationwide fruit fly programme.

The country has fought the Medfly for nearly 40 years. The majestic Andes and long stretches of drylands geographically protect the country from the fly's presence. But the Medfly came into the South American region more than a century ago, and tourism, trade, and traffic can keep it moving. The pests can ruin harvests by injecting their eggs into maturing fruit and vegetables.

Chile has had to win the "fly wars" more than once, Mr. Gonzalez points out. The first eradication campaign started in the late 1980s, through a national programme initiated and funded in large part by Chile's fruit growers and supported by the IAEA. Initially, Chile imported sterile Medflies from SIT facilities in Hawaii, Guatemala, and Mexico and released them across Arica, where the pest was found. Field results were so impressive that Chile decided to build its own plant.

By December 1995, the country had officially won its first long battle. Chile was officially declared a "fruit-fly-free" country, only to have to regain certification five years later.

Efforts were redoubled in 2000 when 193 invading Medflies were detected in the Arica area. Emergency measures kicked in—including intensified monitoring, trapping, and sterile fly campaigns supplied by the Arica plant — to thwart the threat.

Since the 2000 victory, only one fly has been detected, in 2004. Arica was again declared "fruit-fly-free" in December that year. The certification expanded markets for Chile's fruit growers, shippers, and laborers. Exports of fruit from apples and kiwi to cherries and grapes are again running higher than ever.

"Chile is in a leading position as a fruit-fly-free country. As a result, we can export fresh fruit to markets that are closed to countries plagued by Medfly infestation," says Mr. Gonzalez. "But we've had to succeed more than once against the Medfly. The experience shows how constant the threat can be."

Patagonia's Pride

Argentina's Fruit Becomes Even More Tempting

General Roca, Argentina—From a nation famous for prized beef, championship football, and fiery tango dancers, meet Packham's Triumph, a Patagonia pear. Better yet, taste one: *"Deliciosa"*.

Pears like Packham's Triumph are the pride of General Roca, a town in the heart of Argentina's fruit basket. So are apples, peaches, and other fruits. Here, along the fertile banks of the Rio Negro, the town's 80,000 citizens live from the land's green oases. They cultivate orchards sheltered from winds by tall poplars their ancestors planted decades ago.

Today, 69-year-old Enrique Scholz, a Patagonian fruit grower of German ancestry, points to a giant sculpture along the town's main road that pays tribute to the generational story. It's a shiny steel apple seven meters high in the sky—a monument to the hard work and rewards of fruit production in this country.

Each March, Mr. Scholz recounts, the sight becomes the centrepiece of the nation's apple festival. "From blossom time to harvest time, the orchards have been my life for nearly 40 years," he says with a smile.

Esteban Jorge Rial passes by the big apple everyday. He's lived with his family in this countryside for more than a decade, and works for the fruit industry. He helps the region produce top quality fruit. His job is to steer preventive pest-control efforts that protect harvests from mostly unseen enemies, mainly the Mediterranean Fruit Fly, or Medfly as it's notoriously known.

The fruit industry in Argentina and Chile is big business, bringing in billions of dollars a year. Only the best fruit is selected for export at a packing plant in Patagonia, the heartland of apple, pear and deciduous fruit production in Argentina.. Photo: Wedekind/IAEA

Mendoza Eyes New Frontiers

Argentina builds on success

In Buenos Aires, the Ministry of Agriculture in 2005 agreed to fund a new fruit fly management programme involving the SIT. It will cover an area of 56,000 hectares in the north-east provinces of Entre Ríos and Corrientes that are home to profitable citrus fruit orchards. Argentina sells nearly half a million tonnes of lemons, tangerines, and other citrus fruit to overseas markets, mostly in Europe, every year.

The decision rippled through Mendoza, where Oscar de Longo and teams at the province's agricultural safety and quality institute, known as ISCAMEN, prepare for a busier future. The old Medfly plant is being shut down, and a new $10 million SIT facility partly funded by the World Bank is set to brace Argentina's prevention and eradication programme.

The new plant is near the productive southwest Uco Valley, one of four Mendoza oases. Vineyards and fruit farms line a dry and dusty landscape fed from waters of snow-tipped Andes mountains. Beyond the many grapes, farmers there mostly grow pears, peaches, plums and apples for export to Russia, Spain and other European countries.

"The fields in Uco Valley are free of Medflies," says Mr. de Longo, who helped plant some of the area's first fruit trees decades ago and today heads Mendoza's Medfly eradication programme. "Hail and codling moths are now bigger threats to pear and apple trees."

The new Medfly SIT plant can't stop the hail, he notes wryly. But it will double the country's production of sterile male flies to 300 million a week for supplying operations in Mendoza, Patagonia, and nearby San Juan province.

Next up for SIT could be the codling moth. In September 2006, ISCAMEN opened a pilot facility for rearing sterile moths. Field trials in Mendoza are part of new integrated pest-control steps designed to fight the wormy enemy with less reliance on insecticides.

Mr. Rial's work means millions of dollars a year for Argentina's fruit industry. Lately, it's helped Patagonia achieve a coveted status in agriculture and trade circles—officially recognized in late 2005 as a "fruit-fly-free" region by the US Animal Plant and Health Inspection Service (APHIS), the USA's top agricultural inspectorate and respected gateway to global trade.

"The recognition took us over four years to achieve. It's like a stamp of quality that breeds confidence in the fruit we produce," Mr. Rial says with pride, pointing to "fruit-fly-free zone" labels placed on every box readied for shipment at one of the region's 300 packing plants.

The new-earned status makes fruits such as Patagonia pears even more marketable and tempting to consumers the world over. It specifically allows producers to export fresh fruits and vegetables to lucrative USA markets without going through tough quarantine requirements. That alone translates into annual savings of US $2 million, calculates Argentina´s National Food Safety and Quality Service (SENASA).

The elimination of costly quarantine treatments applies to export markets beyond the USA as well. Patagonia sends more than three million boxes of top-quality pears and apples to the USA every year—and about 30 million boxes to countries in South America and Europe.

Opportunities now are opening for other fruits whose cultivation is rapidly expanding. New ground was broken over the past year, when 300 tons of Patagonia cherries were sold to US markets at holiday times in November and December alone, Mr. Rial reports.

The Medfly lives for only about one month in temperate climates, yet is one of the world's most voracious agricultural pests — a veritable "superfly" that global trade and tourism have carried to places far from its natural African home. If not controlled, the invading fly devours ripening fruit. Females pierce the fruit's skin to lay hundreds of eggs that soon become hungry maggots creating infested mush.

Patagonia's Medfly controls are strict and serious to make sure fruit flies stay out. At Neuquen airport, authorities screen passengers and their belongings, using X-ray scanners and surveillance. Inspectors check and confiscate any apples, pears, cherries or other fruit you may want to bring in.

"Even dogs, mainly beagles and labradors, are trained to sniff out fruit," says Mr. Rial. "We know that fruit carrying the Medfly comes here from the outside, from tourists, from packages sent to workers, even from people trying to smuggle food in. Just one fly maggot can put our entire harvests at risk."

Sometimes the flies get in, triggering emergency measures that include restrictions on all movement of fruit and agricultural products into and out of the region. "Quarantines don't make me very popular with the locals," says Mr. Rial. "Producers want to kill me if it happens in high season. Jobs depend on fruit production. But nothing can move until we say so."

Fruit production and protection go hand-in-hand in Argentina. In most years, fruit exports bring in about half a billion dollars to the country's economy, and in good years as much or more as exports of Argentina's famous beef. Patagonia pears are market leaders, with Packham's Triumph, Williams, and Beurre D'Anjou varieties valued around the world.

With that much at stake and limited federal government support, fruit producers are funding their own pest-control programme, Mr. Rial points out. In Patagonia, his employer, the *Fundación Barrera Zoofitosanitaria Patagónica*, rhythmically known as FunBaPa, leads the way.

The emergency programme includes stricter monitoring at traffic checkpoints, intensified fly trapping and spraying in fields, and more frequent release of sterile male Medflies to saturate target zones. The operation's scope and status is mapped using a satellite-directed global information system.

"We use a powerful combination of measures," Mr. Rial says. "There have never been any fruit production losses here due to the Medfly."

Experts from the IAEA and UN Food and Agriculture Organization (FAO) advised Argentine authorities in the 1990s on the use of SIT as part of the country's integrated pest-control strategy. "Their advice was a key, especially at the beginning when we faced so many decisions," Mr. Rial recalls.

A province away, the country's SIT facility in Mendoza — where fruit-fly-free zones already have been established— also gained from FAO/IAEA expertise. Researchers at IAEA laboratories near Vienna developed a genetic sexing strain of Medfly for mass-rearing factories. The Mendoza plant produces the strain to rear only male sterile flies for SIT campaigns in Patagonia and elsewhere. The work benefits more than 15,000 fruit and vegetable farmers nationwide.

California's Terminator

News Flash, September 2004: "Medfly Infestation Threatens San Diego County" "Aerial Releases of Sterile Medflies to Begin in San Diego County"

San Diego, USA—Californians have been battling the Medfly since Ronald Reagan governed the golden state. The invasive pest is among the worst threats to the state's multi-billion dollar fruit and agricultural industry.

"If the Medfly were to become permanently established, the estimated economic loss would be as much as $1.9 billion annually," warns the California Department of Food and Agriculture.

That's near the gross domestic product of many countries in the world. Just one fly's mere presence triggers market alerts from Sacramento to Saskatchewan to Sapporo— together Canada and Japan buy more than half of all fresh fruit the USA exports.

So the little fly is a big deal. It's nearly as dangerous to politicians as it is to pears, pomegranates and many kinds of fruit.

In 1982, a Medfly outbreak threatened California fruitfarms and helped spell the end of then-Governor Jerry Brown's bid for election to the United States Senate. Pundits

California Governor Arnold Schwarzenegger stands before a giant image of himself as Hollywood's "Terminator", as he promotes the state's fruit and agricultural products in Japan. Photo: gettyimages

say the Governor mishandled the fight against the fly, sending his approval ratings downhill. He lost the Senate race.

Today, the Medfly menace challenges California Governor Arnold Schwarzenegger, the former Hollywood actor of "Terminator" movie fame. The Governor teamed with state Secretary of Agriculture A.G. Kawamura in 2004 to take on a high-profile Medfly case. An outbreak in Baja California, Mexico, threatened San Diego County about seven miles across the border.

The news triggered emergency actions from Tijuana to El Paso. Californians quickly partnered with authorities from Mexico, the US Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), and border and customs officials in Texas, Arizona, and New Mexico to stop the Medfly's advance. Controls and quarantine restrictions were put in motion that lasted for nine months before the emergency was declared to be over.

Among the modern tools of combat: the sterile insect technique (SIT), a form of biological birth control that's become quite a "terminator" itself. Male Medflies are factory-reared and sterilized, then released by air to saturate threatened areas. The result: a stacked deck when it comes to mating—sterile males mate unproductively with any females around—and Medfly populations are terminated.

Against the 2004 San Diego threat, 15 million sterile Medflies reared at APHIS facilities in Hawaii and Guatemala were flown into southern California, then systematically released by air over San Diego County and Tijuana, Mexico for weeks to infiltrate target zones. The steps were part of California's emergency plan under an anti-Medfly programme set up in the mid-1990s to guard against infestations. The SIT has won favour because it works well in combination with fly-trapping and other area-wide tools to fight pests and specifically cuts down on the use of chemical sprays.

No Medfly ever made it into southern California in 2004.

"The Medfly is a serious threat to agriculture that demands quick action," says California Secretary Kawamura. "Sterile Medflies are an outstanding, environmentally responsible tool for combat against a major pest."

Winning Multinational Teams

The IAEA has helped California authorities beat the Medfly. Scientists in the Joint Programme that the IAEA runs with the UN Food and Agriculture Organization (FAO) support SIT research and provide technical and scientific advice. Mr. Jorge Hendrichs, an entomologist from Mexico who heads the Insect Pest Control Sub-Programme, sits on the board of California's Medfly science advisory panel.

A veteran of anti-Medfly and SIT campaigns, he credits sustained and steady efforts for winning the fight against the Medfly. The first large SIT campaign targeting the pest was in 1977 in southern Mexico. The fly had invaded Costa Rica in the 1950s and made its way through other Central American countries, threatening their Medfly-free status.

"The US announced it would close its border to Mexican fruits and vegetables if the Medfly crossed the Isthmus of Tehuantepec near the Guatemala border," Dr. Hendrichs recalls. "An emergency programme was launched, integrating pest suppression tools with the first large-scale application of the SIT."

The multinational project—known as "Moscamed", Spanish for Medfly—stopped the fly's northern spread by 1982, effectively creating a buffer zone saturated with sterile flies. The SIT barrier has worked for three decades, keeping northern Guatemala and Mexico, and indirectly the USA, free of the Medfly. Today Project Moscamed produces over two billion sterile male flies a week in Guatemala at the El Pino facility, the world's largest Medfly rearing plant. The factory supplies SIT campaigns in Guatemala, Mexico, USA, and other countries.

Even so the risks to Mexico's $3 billion fruit and vegetable export business and the USA's huge agriculture markets remain high. In the US, a $60 million strategic plan targets the Medfly and other exotic fruit flies. The aim is to protect more than $7 billion worth of US fruit and agricultural crops—mostly in California, Florida, and Texas—most susceptible to fruit fly infestation.

In California, a particular target of Medfly prevention is the bustling Los Angeles area. Multiple commercial air and shipping ports sharply raise the risk of pests entering the state via travel and trade.

"The preventive release programme started in 1996 and today keeps more than 6000 square kilometres of the Los Angeles Basin area free of the Medfly," Dr. Hendrichs says. The SIT became a staple tool following public opposition to pesticide spraying campaigns over urban areas.

Though Medflies continue to be detected in the LA area from time to time, no major outbreaks have occurred for more than a decade. That's both an indication of the programme's results and of the constant threat the Medfly poses to California fruit. About 300 million sterile flies are released each week.

"We know the SIT strategy has been successful technically, politically, and environmentally," Dr. Hendrichs says. "While no silver bullet, it's a valuable weapon against pests that can ravage crops and threaten a nation's agricultural economy."

The Middle East's Fruitful Valley

Against the odds, Israel, Jordan & the Palestinian Authority set up "no-fly" zones of a peaceful kind.

by Kirstie Hansen

Arava Valley, Middle East —Their people share an agricultural valley, and now they share the fruits of partnership – to the tune of millions of dollars every year.

Scientists, politicians, and farmers from Israel, Jordan, and the Palestinian Authority are winning a long and largely invisible fight against the odds. Their common foe: the Mediterranean fruit fly, or Medfly, one of the world's most destructive agricultural pests. Among their allies: the IAEA, UN Food and Agriculture Organization (FAO) and tools of nuclear science and technology.

At a military checkpoint between Israel and Jordan in the Arava Valley, a precious cargo is traded. One-hundred and fifty-thousand sterilized male flies. Trapped in a dozen brown paper bags, they buzz as they pass from Israeli to Jordanian hands.

Later that day, a plane loaded with seven million flies will make a two hour flight from the Red Sea to the Dead Sea. It is the only plane authorised to tick-tack between the two countries in this region where military "no-fly zones" typically rule.

Twice a week, Steve Carrigan becomes the friendly "fly bomber", releasing swarms of sterile male flies by air to overrun the Mediterranean Basin's shared Valley. The Medflies are commercially bred for birth control; their mating yields no offspring. If left to multiply in the wild, Medflies would wreak havoc on citrus and other fruit, quickly turning crops into infested mush.

Scientists call the pest-control technology the sterile insect technique (SIT). It is an environmentally friendly method, with a basic "birds and the bees" concept. No offspring means a dwindling fly population over time, through systematic and targeted campaigns combined with other strategic measures on an area-wide basis.

That's what's happening in the Arava Valley. The ultimate goal is eradication from the Valley.

"We're using a pest to fight a pest," says Jordan's Minister of Agriculture, Mostafa Qrunfleh. "Together with partners, we're winning." The IAEA and FAO have supported the project since the mid-1990s.

For Israeli farmer Ezra Ravins, success means he can sell his bell peppers to lucrative export markets like the USA where imported fruit and vegetables must come from fruit-fly-free zones. The bell peppers are grown inside enormous greenhouses—cool oases of reds and orange on lush green plants — that dot the desert landscape. Mr. Ravins says the SIT programme helped to convince tough European and US regulators that his produce is free of infestation.

For Israeli farmer Ezra Ravins, success means he can sell his bell peppers to lucrative export markets like the USA where imported fruit and vegetables must come from fruit-fly-free zones.

Photo: Ilan Mizrahi/IAEA

Business is booming for the "clean" fruit. Bell pepper production in Arava Valley has grown a hundred times since the programme started, from less than $1 million a year in 1998 when the programme started to $120 million in exports last year. Pesticide use has fallen.

Across the valley in Jordan, Abdullah Ja'afreh sees his fruit farm production rising. He and other growers are exporting to their Gulf neighbours and entering Eastern European markets. Yields have improved and there's better quality fruit for the local market.

"The Medfly is not the big problem it once was. Ten years ago you would see infestation on guavas. Now not," Mr. Ja'afreh says.

The IAEA and FAO first helped to set up pilot projects and supply sterile male Medflies to Israel and Jordan in 1998, four years after Israel and Jordan signed a peace treaty and related cooperation agreements. The Palestinian Authority joined the partnership one year later, and now has the capacity to adopt the technology. The IAEA funded the partnership for many years, and so did the USA, including a four-year, $2.5 million grant.

The sterile flies are bred in a commercial mass-rearing facility in Israel called Biofly. Among the specialists there is Inbar Shouster-Dagan, who was trained on mass-rearing techniques at the IAEA's Seibersdorf Laboratories and in Chile. She says that 20 million sterile male flies are produced there each week for release into the wild. Plans today are to expand the science alliance.

In the Gaza Strip, Palestinian fruit growers already have placed bulk orders for sterile Medflies, and hopes are high that the SIT project can resume as political conditions allow.

Interest is strong in other areas of Israel and Jordan. In Ashqelon near Gaza, Michael Noy manages fruit and vegetable farms with a $200 million annual turn-over. He also wants to benefit from SIT-based campaigns. "Every year more and more chemicals are banned," Mr. Noy explains. "Ten years from now there may be no other option. Consumers want quality fruit."

Farther north, beyond the Arava Valley in Jordan, the story is much the same. Farmers rely heavily on pesticides to control Medflies and other pests. Even so, Ahmad Mustafa Massadeh complains that the Medfly destroys about 25% of his crop.

Mary Bahdousheh coordinates the Medfly project in Jordan, as the Head of Agricultural Pest Control. Unlike the mistrust clouding the Medfly partnership with Israel in the mid-1990s, years of cooperation and communication since then have paid off, she says. With the IAEA's help, Ms. Bahdousheh brought Jordanian farmers like Isac Medanat across the border to see first hand what was happening on the Israeli side of the Valley, and to speak with experts and their farming neighbours.

A prime focus today in Jordan is making sure that bustling cities like Aqaba in the south do not become potential "hot spots" for Medfly outbreaks that could place Valley harvests in the north at risk. Jordanians like to grow fruit trees, like kumquat and lemon, in their gardens, and pest-control and monitoring programmes have to be strict in urban areas.

Jordanians like to grow fruit trees, like kumquat and lemon, in their gardens, and pest-control and monitoring programmes have to be strict in urban areas.

Photo: Ilan Mizrahi/IAEA

"An outbreak would be a disaster for commercial orchards," says Jean-Pierre Cayol, an entomologist and the IAEA programme management officer for the Medfly technical cooperation project in the Middle East.

For the region's agricultural leaders, the success of the project feeds hopes. "As much as this may sound remarkable, the Medfly acts as a bridge to peace," Israel's Minister of Agriculture, Shalom Simhon, says. "We're working together to protect our shared region."

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