Pioneered in the 1950s, the sterile insect technique (SIT) has allowed farmers worldwide to reduce populations of pests that prey on their crops and livestock by releasing infertile males into the mix. While the method has been effective in many cases, pests remain a challenge for growers in terms of both orchard management and export market access. To address some of the pitfalls of using traditional SIT, U.K. company Oxitec is using germline transgenic technology, in search of a more efficient and cost-effective process.

Oxitec scientist Neil Morrison says his company's products could help the industry overcome two common SIT problems - difficulties in guaranteeing male-only insects and competitive impacts from irradiation.

Releasing males is key because it is the female pests that lay eggs on fruit or bite people when it comes to human disease, but Morrison says it is hard to naturally develop sexing strains that allow for male-only release.

"Male-only release is essentially a very good idea because your males after release are not distracted from their intended task of finding wild females," he tells *www.freshfruitportal.com*.

"The irradiation process to sterilize the males is damaging to the fruit flies themselves, and so the insects are of less quality. This means you have to release more males to compensate for that deficit in quality."

He adds that traditional SIT projects tend to need funding from large governmental or international organizations, due to the "enormous" start-up costs involved.

"You need to purchase an irradiation source which is a security risk and it's expensive - that cost justifies large area-wide programs."

Photo: Oxitec

In contrast, a project to release genetically modified sterile insects makes smaller projects more feasible, according to Morrison. Potential buyers could range from individual farmers to co-ops to governments.

"We have developed a genetic means of producing large numbers of male-only fruit flies, and also a form of genetic sterility which allows us to avoid the irradiation process. The objective of that is really to produce better quality males," he says.

The process involves inserting genes into the insects so that all males are sterile, and

females cannot survive in the absence of a dietary antidote - to date this has been tetracycline, a drug often used in acne and cholera medication.

"That rescues the lethal phenotype, and then in the generation before release you remove the tetracycline and you produce males only.

"When we're developing the strains we see a lot of variation in the extent of the lethality [death of female insects]. In some strains we may see 50% lethality but in other strains we might see 100%. Those are the ones we then develop further."

For agriculture, the company currently has product strains for Mediterranean fruit fly, Olive fruit fly, Mexican fruit fly, Diamondback moth and Pink bollworm. The scientist emphasizes these insects have been strategically selected due to the years involved in develop each one.

"We've essentially used the same technology in these species and that really tells us that we can transfer this technology quite readily to new tephritid fruit fly species.

"Generating the strains and characterizing them in the lab and doing different performance tests in the lab might take three years or so. Then after that we take them possibly to greenhouse cage trials, and if they perform well in them then we take them to field trials as the next step."

The pests concerned

For fruit flies, he says Oxitec is looking at doing field trials but nothing is set in stone yet, with places like South America or around the Mediterranean as potential testing areas.

"We've done cage trials but that work is ongoing and not yet published. What is published is with Olive fruit fly and Medfly, and just the Olive fly has had the cage experiments."

He adds the company is looking closely at the possibility of applying the technology to the Spotted Wing Drosophila pest, which attacks small fruit and tree crops.

He says the company is looking to provide products where unmet needs exist, especially in cases where certain agricultural areas are unable to export their products to specific markets due to the presence of a pest.

"A good thing might be to locally suppress a population to near zero, through example in a mango-growing area of a different country, and because our technology relies on the mate-seeking behavior of the male flies, it works against really quite low numbers of the wild fly.

"It's almost uniquely effective and efficient against low insect populations as well as high insect populations, so if you can target a population early in the season before it goes up, with this kind of method you should be able to keep a population down rather than the anticipated increases as the season progresses."

From human health to agriculture

Morrison says the company's lead product is the dengue-carrying *Aedes Aegypti* mosquito, with development trials that have reached the commercial testing phase.

"Dengue is the fastest growing insect borne disease in the world as far as I know, so there's hundreds of millions of cases every year of new deaths.

"We have conducted field trials with our genetically sterile mosquito strain in the Cayman Islands in the Caribbean, and also in Brazil.

"In both arenas we've targeted the mosquito population in small urban areas, and achieved between 80-95% suppression of the wild population."

He adds the developer is currently in the process of starting a commercial trial in Brazil in a much bigger urban area of about 50,000 people.

www.freshfruitportal.com