A single mutation causing striking, unpredictable resistance against mites and insects, reveals the common mode of action of putative different insecticide classes

The sustainability of agricultural output, which needs to nearly double in the next 30-40 years to maintain food security and meet predicted population growth, is seriously threatened by insects and mites that devastate crop production. The protection of agricultural production largely relies on the use of insecticides. However, the increased use of insecticides in agriculture place an immense genetic pressure on insect pests that has resulted in the selection of Insecticide Resistance (IR). Rotation of insecticide classes with different Mode of Action (MoA) is a major way to manage the phenomenon.

The Molecular Entomology group, headed by **John Vontas**, with **Vassilis Douris as** the main researcher, and their collaborators, discovered that a single mutation conserved in both mites and insects, causes striking and unpredictable resistance against different insecticides, believed to belong in different groups. By using the innovative molecular technology CRISPR-Cas9, a genome modification technique which allows, among other uses, for the introduction and evaluation of single mutations without any other alteration in the genome of the target organism, the researchers introduced the mutation which was found both in mites and insects (Figure 1), in the chitin synthase gene of a *Drosophila* strain, and showed that it was converted into an extremely resistant against three putatively different insecticide classes (benzoylureas, buprofezine and etoxazole), as thought for several decades. The findings resolves an old enigma in insect toxicology, the mode of action (MoA) of the IGRs benzoylureas, buprofezine and etoxazole, insecticides which have been used extensively against vectors of human diseases and agricultural pests, provide novel insights into their management and may facilitate the development of insecticides with greater specificity and potency. The work is published today in Proceedings National Academy of Science (PNAS).

“It is a highly innovative and very important research, which elucidates unexpected resistance and mode of action mechanisms of major insecticides used for many years in agriculture. It promotes the international recognition of FORTH/IMBB and significantly contributes to the establishment of excellence in the Agri-food sector”, **Nektarios Tavernarakis**, the **President of FORTH** and Professor at the University of Crete, said.

Figure 1. Resistant larvae of diamondback moth *Plutella xylostella*, one of the most destructive pests worldwide, is feeding undisturbed on sprayed plants and are not affected by high insecticide doses which should “normally” kill them.