

## ON THE ORIGIN OF RESISTANCE



Almost 150 years ago Darwin formulated the blueprint for life in all its diversity: the survival of the most adapted was evident. This struggle for adaptation is the engine of a never ending story of evolution, change and disappearance of species. One can be curious how life will look like in the far future. Unlike mammals, insects (characterized by a very short lifecycle and rapid propagation) can develop genetic change - or better genetic selection - on a relatively short time scale; Insects could become resistant against control methods such as fumigation.

Insects have developed resistance against a wide range of insecticides, but also against phosphine, the most commonly used fumigant in stored and shipped agricultural commodities. An extensive study in Australia showed that at the end of the 1990's weak resistance had already spread widely with almost half of the samples collected from stored commodities containing insects with weak resistance to phosphine. More alarming, however, was the observation during the first decade of this century of strong resistance emerging in several species: the lesser grain borer (*Rhizopertha dominica*), the rust-red flour beetle (*Triboleum castaneum*), the saw toothed grain beetle (*Oryzaephilus surinamensis*) and an extremely strong level of resistance in the flat grain beetle (*Cryptolestes ferrugineus*).

Resistance can be explained by natural instability of the insects' genome and by the great reproductive capacity of most species. Any given population of insects could become resistant against a chemical if they are repeatedly exposed to inadequate (sub-lethal) concentrations. As soon as one insect in a colony has become resistant, its offspring will become dominant and spread rapidly in the population due to its advantageous adaptation and spread rapidly.

Although it is believed that resistance was originally developed in South East Asia Pacific, resistant insects are today a global threat to trade of agro commodities. Repeated fumigation in poorly managed warehouses and inadequate sealing/gas tightness preparation has undoubtedly been the trigger for resistance development. Whilst resistance has been observed for some time, rapid and global spreading is now occurring at a much faster pace due to the absence of alternative fumigants for insect control. Indeed, until 2005 many commodities were fumigated pre-shipment, or in case of suspicion of resistance, with methyl bromide. Because of its phase out in line with the Montreal Protocol, stakeholders in the food and feed supply chain have been confronted with the disappearance of the limited alternatives for insect control in bulk commodities. Additionally, we are on the brink of high resistance to phosphine.

This is why we at SGS are convinced of the importance and application of best practice. Best practice in phosphine fumigation requires an array of

competences and focal points: sealing, conditions of the goods, homogenous diffusion of the fumigant, concentration and exposure time.

Some essential elements for successful fumigation are sealing and exposure time.

It is obvious that a good fumigation starts with good sealing. If the fumigant gas can not be maintained in the object or treated commodity, the result will be poor. In addition, exposure time and concentration go hand in hand, time being the decisive factor. As opposed to other gases, when dealing with phosphine, a further increase of concentration above the optimum will not result in a better fumigation, while an increased exposure time will always lead to a more reliable result. We must however often conclude that, time is money and that exposure times are often insufficiently respected, even more in trade related business. An initial assessment of the insects involved is essential to mitigate the risks of insect survival.

This general approach must be substantially reviewed when dealing with tolerant strains, which may need higher concentrations and will undoubtedly and with no exception require longer exposure times.

SGS has extensive expertise in fumigation. Today our network in key export and import areas is protecting your interests and will closely monitor that best practices are implemented. Ignoring the essentials is compromising the limited solutions we have for insect control, better to call in the professionals.