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RESISTANCE TO PHOSPHINE: AN UPDATED OVERVIEW

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With the cessation of methyl bromide (MB) fumigations in the post-harvest sector, phosphine has become almost the only fumigant permitted on food products and its use has increased accordingly. However, by our own actions in carrying out defective fumigations we are permitting the development of resistance by stored product insects that are threatening its very future. Over the first two decades since it was first reported in 1976, resistance levels were relatively low. They were attributed to an active exclusion mechanism, for which the major gene is semi-recessive, and the heterozygous strains are little different in susceptibility than the susceptible ones. Consequently they should be controlled unless very poor fumigations were carried out. Also MB was advocated in the past as an alternative that would eliminate resistant strains to phosphine. Yet phosphine resistance has continued to evolve in spite of the precautionary measures that were advocated. Since the first detection of resistance to phosphine, data have accumulated over time and space that indicate its existence in most regions of the world. We also know that resistance is particularly problematic in developing countries where hot climates favour shorter generation times, and sealing techniques are often well below standard. The documented reports from countries such as Bangladesh, Brazil, the Philippines and Australia are largely due to the fact that studies have been carried out in these countries, whereas in others no resistance detection programs are in place. Some recent studies have revealed the development of "highly" resistant strains both in *Rhyzopertha dominica* and *Sitophilus oryzae*. For "weak" resistant strains, resistance factors are in the ten-fold order, whereas the "highly" resistant strains are at the hundred fold level. Every country needs to know what levels of resistance occur among their important stored product insects. However resistance determination by the 1976 FAO method No. 16 is prolonged and requires laboratory facilities and technicians that are not always available. Rapid test methods have been explored and are based on knockdown. A kit has been developed but it does not include charts for use with *R. dominica* or *S. oryzae* the two most important grain pests in the tropics.

To combat resistance there is a theoretical choice between increasing dosage and increasing exposure time. However, in practice due to insect response to phosphine, the option of increasing dosage does not exist. Of the several grounds for choosing the exposure-time option, the difficulty in increasing concentrations in incompletely sealed structures is perhaps the most important and the less understood by pest control operators. To save phosphine from extinction there is an urgent need to publish, to teach and to enforce suitable fumigation protocols, and to carry out appropriate revision of labels.

Key words: Stored product insects, phosphine, resistance, methyl bromide