

Controlling insects during storage

Alternatives to dichlorvos after it is banned

The new Maximum Residue Levels set by European Regulations for the use of two storage insecticides are so low that it is no longer possible to apply them directly to grain. There are already solutions to replace malathion, but none to replace dichlorvos. Here are details of the measures required to compensate for their withdrawal.



Grain cleaning is becoming a must

European regulations on the use of insecticides in storage are becoming more stringent. The withdrawal of malathion and dichlorvos has been scheduled for 2008, but already their Maximum Residue Levels (MRL) have been reduced so significantly (0.5 ppm and 0.01 ppm respectively), that it is no longer possible to apply them directly to grain.

There are already solutions to replace malathion, including using three molecules which are still permitted: chlorpyrifos-methyl, pirimiphos-methyl and deltamethrin. But there are no available alternatives for dichlorvos (DDVP), which was the only "shock treatment" insecticide to help treat grain batches infested with insects shortly before dispatch.

Its disappearance will mean having to implement new measures from this autumn onwards.

Cleanliness of premises is essential

Cleaning premises and equipment is foremost on the list of insect control measures, since it helps eradicate any sources of protection and food that insects need when silos are empty of grain.

When facilities are not in operation, using compressed air is often enough to loosen dust deposited in the upper regions of the installation and make it fall to the ground. However, this is not effective if the premises were infested with moths, especially *Plodia interpunctella*. This is because the cocoons woven by the caterpillars before becoming chrysalides adhere very strongly to surfaces and their removal requires brushing down. Then vacuum cleaning is the only way to gather all those undesirable particles. Those operations are all potentially difficult to achieve safely by silo staff. To meet this need, specialist companies are appearing on the market.

Internal cleanliness of ventilation shafts and channels must be checked and rectified if necessary. As a rule, all corners in which dust or grain may have settled must be checked. It is important not to forget to destroy all the dust gathered.



Stock monitoring is crucial to assess risks



Preventative insecticide treatment is a plus

Following this indispensable first step designed to make surfaces as clean as possible, walls and premises must then be treated with insecticide. This is achieved by spraying walls and partitions with insecticide mixed with water, or by using smoke bombs or aerosols in the premises, making sure to comply with the instructions given by the product manufacturer. The three molecules that have been reregistered in Annex I are perfectly suited to this task. Note that dichlorvos and malathion can still be used for those treatments, until they are finally banned (at a date not yet set by the French government, but by December 2008 at the latest). However, one preventative measure must be taken in order to avoid polluting the grain: insecticides must not be applied to the inside of cylindrical and flat storage bins and treatment must take place around two weeks before the grain is stored in the bins.

Then, cleaning the grain helps control insects in several ways. Larvae (except those of weevils) need fragments and dust particles to develop. If present, their development is slowed down if the grain is clean. This cleaning process will improve the homogeneity of the mass of grain, which helps it cool down.

Ambient air cooling ventilation is by far the best tool to control insects.

Furthermore, eliminating part of the bacteria, yeasts, moulds and mycotoxins from the field through the cleaner will help improve the safety quality of the grain.

Temporary sealing of the upper regions of a bin.

Ambient air cooling ventilation must be implemented as soon as possible when the bins are being filled. The aim is to bring grain down to a temperature below average ambient temperatures, in order to dissuade nomadic insects from settling in it: minding the feeling of cold, they do not penetrate the grain. Later, the aim is to lower the temperature in successive stages, down to around 12°C in order to put the insects that may be present into a vegetative state and stop other insects from colonising stocks. Then, if the grain must stay in silos until summer, a final winter ventilation must lower the temperature to nearer 5°C and achieve a complete insecticide effect (eggs, larvae, adults) in around 3 months.

Approved treatment rates for various active ingredients (tab. 1)			
	Premises		Grain (g/t)
	area (g/m ²)	volume (g/m ³)	
Malathion	0.50	40.0	
Chlorpyrifos-methyl	0.56		2.5
Pirimiphos-methyl	0.20	7.0	4.0
Deltamethrin	0.50		0.5
Dichlorvos	1.00	7.5	

Malathion and dichlorvos can no longer be applied directly to grain.

In order to carry out those operations as safely and as quickly as possible, regardless of overall seasonal weather conditions, a thermostat must be fitted and connected to a timer, to achieve the most effective and efficient management of on and off ventilation periods.

Monitoring the temperature of grain stocks is essential to assess storage quality and manage cooling ventilation. Any unexplained rise in grain temperature is often due to the excessive moisture content of the grain. It can also be indicative of insect presence. Setting traps can then help ascertain whether they are indeed present, or pre-empt the problem, if the traps are put in place at the very beginning of storage. Static traps set in the top 50 to 60 cm of the heaps are clear indicators of insect presence in this vulnerable zone. New detectors equipped with acoustic pick-ups have appeared on the market, with semi-portable or mobile systems. They make it possible to identify the species and growth stage of the insects. Their full-scale effectiveness is strongly disputed by storage facility companies and still remains to be validated.

When all possible precautions have been implemented, chemical insecticide treatment is still the last but indispensable resort in case of insect presence.

The scheduled ban of dichlorvos necessitates a review of strategies of batch preparation before shipping. Although the remaining three molecules (chlorpyrifos-methyl, pirimiphos-methyl and deltamethrin) are effective in killing all free forms of insects, they take between 48 and 72 hours to do so, unlike dichlorvos which was effective in less than an hour. For an insecticide treatment by fogging to be effective, it is absolutely crucial to use the dosage recommended by the product supplier. This implies regular monitoring of the actual flow rate of the treatment equipment, as well as the handling flow. After this operation, the grain must go through a cleaner-separator, to eliminate dead insects, especially after a substantial infestation.

Resorting to fumigation

In the current situation, grain fumigation (gas injection) is the only technique available to kill all insects, in all their forms, without leaving any insecticide residue. However, its implementation raises a number of issues due to current storage systems, including the fact that bins are not sealed, as well as due to complex administrative requirements regulating its use. Even if spot treatments are a possibility, with the assistance of specialised companies to temporarily seal bins, putting “hospital” bins in place inside pooling silos seems to hold the key to future improvement of insecticide treatments. However, even fumigation does not entirely solve the problem of the last minute treatment of an infested batch of grain. It still takes between 24 and 48 hours to kill all free forms of insects contained in a batch of grain. The only active ingredient still currently approved in France is hydrogen phosphide (phosphine). The speed of effectiveness of the chemical treatment slows down as the temperature falls, which means that exposure time will have to be longer in properly cooled grain. This gives to the preparation of facilities the importance it used to have and deserves. Prevention is better than cure!

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The purpose of cooling ventilation is to bring the grain down to a temperature below average ambient temperatures, in order to dissuade nomadic insects from penetrating into the grain.