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Stored Grain Pest Management in Organic Systems

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Introduction

Grain stored in bags and bins may get infested with insect pests, which can result in significant post-harvest losses, deterioration, decreased prices, or rejection of the grain by buyers. An IPM strategy including sanitation, identification, monitoring, and preventive practises is required for the effective control of stored grain pests without the use of synthetic pesticides. Before harvest and throughout the storage period, insect control for stored grain must begin. Before implementing new procedures or utilising novel ingredients, always verify with your organic certifying organisation.

Measures to Take Before Binning

Sanitation:

Avoiding stored grain insects is the best course of action. Sanitation aims to get rid of adult and pupal insects, as well as their eggs. Never transfer freshly harvested grain to bins with older grain. Remove any remaining grain from the bins, and then use shovels, brooms, and industrial vacuums to remove dust, webbing, and fines from any crevices, doors, seams, vents, and in particular from underneath false flooring. Old grain or fines that have been left in the bins, even in tiny quantities, may have insects that can start infestation again. Before storing new grain, clean all of the conveyors, lifts and fans. Once the bins are clean, check them over and seal any holes or gaps that could let moisture or insects inside. Apply a grain protectant that is approved for use in pre-harvest spaces to clean bins as a pretreatment. Before utilising new materials, always double-check with your organic certification organisation. When cleaning and sanitising bins, always wear the appropriate safety gear (such as a respirator and an air helmet).

Clean the grain-transporting machinery, including the augers, conveyor belts, and combine headers. Clean the combine by removing the first few bushels of old grain, then load

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the gathered grain onto a fresh truck. Keep the area around grain storage weed- and grain-spill-free.

Prevention Techniques when binning

- **Cleaning grain:** The ability to store grain can be enhanced by using a cleaning. This is crucial when storing grain that is moist, damaged, or immature. To lessen the amount of grain breakage, particles, and foreign material, proper combine adjustment should be used. Grain cleansers can be any of the following, but not just:
- **Gravity Screens**: During handling, these straightforward cleaners pass the grain over a screen. Gravity screens can be independent units that receive their feed from an auger conveyor or they can be a permanent installation, like those seen at bucket elevator outputs.
- **Perforated Auger:** As grain is carried over the auger, the fines are separated by the perforations in the auger housing. When the auger is running at full capacity, this kind of cleaner has a limited amount of effectiveness. However, using the auger at a capacity lower than 100% can cause more grain damage.
- **Rotating Screen:** The screen turns and separates grain particles from the grain. If used and sized correctly, they can be quite efficient cleaners. The manufacturer should be consulted for detailed operating guidelines.
- **Aspirator Pre-Cleaners:** Before the grain is dried, aspirators employ airflow to remove dust, chaff, husks, awns, and other materials that are lighter than the grain. To remove things lighter than the grain, grain is internally scattered across the aspirator chamber's breadth, and air is drawn through the cascading grain. Most crops can be accommodated by changing the airflow rate.

Preventive Measures after Binning

After binning, preventative measures include monitoring of grain storage facilities. Commercially available traps of various types are used to check facilities for pests that live on stored grain. Depending on the pest, lures could be food attractants, male aggregation pheromones, or female sex pheromones.

Insect infestation can be detected by changes in temperature, carbon dioxide levels, and feeding damage. Insects emit heat during respiration, and 'hot spots' can form in areas where there are a lot of insects present. Grain temperature can be obtained using probe or

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permanent thermometers. Insects can inflict major damage before they are discovered, and hot spots can be quite localised and challenging to locate. Increased carbon dioxide levels in the grain are a sign that insects were present in the storage bin when the infection first started to spread. Every two weeks, air samples are taken from monitoring tubes that have been inserted into the centre and top of the grain.

Top of the grain mass:

Check the top of the grain mass to see if any insects there. An insect infestation is indicated by a musty smell, clumped grain, dampness on the inside surface of the bin roof, webbing on the grain surface, insect larvae, adult beetles, or moths. Webbing and insect infestation on the grain mass's surface are typically indicators of Indian meal moth activity. Removal of the webbing and broken grain can help to lessen the infestation because this insect only eats the top 12–14 inches of the grain mass. After filling the storage structure, if the grain was properly levelled and the grain surface coated (capped) with an acceptable material, do not break or disrupt the protective layer unless you can re-treat the surface. There are pheromone traps available to keep an eye out for Indian meal moths.

Interior of the grain mass:

Using sticky pheromone traps, probe traps, and plastic tube traps the interior of the grain mass can be observed through the side access panel. These traps are dropped into the grain mass for a predetermined amount of time, after which they are pulled out. These kinds of traps will draw insects and enable the identification of the species and quantity of insects present. Direct examination of grain taken from the side door using a grain probe is a quick but less precise way to sample the grain mass for insects. Deep probes should be removed from various parts of the bin, and the grain should then be gathered and put in a container so that insects may be observed in the grain. These grain containers should be kept in a warm environment so that the grain can warm up to a temperature of at least 60°F or higher, which will encourage insect activity. It is generally accepted that if insects are discovered in a 1 quart sample of collected grain, the grain content of the bin should be immediately used before grain quality is detoriated by insect activity, even though there are no accurate thresholds for the majority of insects found in stored grains.

Physical Techniques for the Exclusion and Control of Insects in Stored Grain

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Physical exclusion:

To prevent the accumulation of fines beneath the floor, use a small perforation bin floor. Fines that may contain insect infestations are moved downward by stirrers and gather at the bottom of the bin. Grain should be redistributed in the bin so that the top is level to allow for airflow. Moisture accumulates in the peaked grain bulk as a result of improper levelling. Even in bins with stirrers, fines can have a tendency to collect in the middle, which could reduce airflow in the bin core and cause hotspots to form. Although the grain's outer borders may appear to be dry, the grain mass's inside conditions could be moist, providing a breeding ground for mould and insect infestations. Redistributing grain from the bin core to the top of the bin on a regular basis will help prevent fines from accumulating in the core of the bin during long-term storage.

For the preservation of organic grains, hermetic sealing or vacuum sealing to create a low oxygen environment are acceptable techniques. When used for 1 to 4 days at typical room temperatures, oxygen concentrations of 1% to 2% are insecticidal to all significant stored product insect pests.

Temperature regulation and aeration:

A key element of stored grain pest management is the use of low volume airflow rates to cool stored grains (aeration). The standard range for airflow rates is 0.1 to 0.5 cubic feet per minute (cfm) per bushel. A consistent airflow and successful drying depend on clean grain. Many stored grain insects are vulnerable to cold temperatures since they are tropical natives. Most require temperatures above 60°F, while some require temperatures above 70°F, to reach populations that can cause damage. Thus, storing grain in a cold environment will inhibit the pest infestation. Pests can be killed by extremely cold temperatures; certain species can be destroyed by storage at 0°F for four days. Insects that infest the grain become inactive when the mass of stored grain is cooled to 50 to 55°F. Warm autumn weather spikes raise the possibility of late-season infestations. In the spring, the grain mass should be warmed to a minimum temperature of 60°F to avoid moisture condensation on bin walls and subsequent insect and mould damage.

Insects require oxygen to survive in low oxygen environments. Both naturally occurring gases, carbon dioxide (CO_2) and nitrogen (N_2), can be utilised as fumigants to produce low oxygen environments. Airtight bins, silos, and specialised equipment are needed

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to provide a low-O_2 environment. By blowing the existing, oxygen-rich air out of the top for two or more days, CO_2 or N_2 gas is forced into the base of the bin or silo.When kept at 2% oxygen for 21 days with grain temperatures above 77°F, adult insects cannot survive. This time frame is increased to 28 days for grain that is below 77°F. The day following fumigation, the O_2 content in the bin or silo must be tested, and it may require additional purging to remove oxygen that has dispersed from the grain.

Some insecticides are permitted in grains stored organically:

BT stands for *Bacillus thuringiensis*, a bacterium that can be used topically or to empty grain bins to prevent or manage nuisance moths like the Indian meal moth. The product is only effective on caterpillars& not every B.t. product is designed for organic systems.

Pyrethrum: A broad-spectrum natural insecticide known as pyrethrum is made from the flowers of chrysanthemum family. Pyrethrum primarily acts as a contact toxin and quickly penetrates insects' outer covering. It is transient and breaks down quickly in the sun. Treat the bin when it is free of product, apply a protectant to the grain as it is placed in storage, then spray the grain's surface after storage for best effects.

Biological control:

Using bacteria or predatory insects to control pests is known as biological control. The cost of this method, the possibility that grain protectants will harm biological control agents, and the presence of live beneficial insects and insect parts in the grain are some drawbacks.

Grain Recovery

It is advised to use grain right away for livestock feed or another application where insects won't affect the final product if infestations of different flour beetles, grain weevils, or other stored grain beetles are discovered infesting the cold grain mass. Animals should be fed the grain before warmer weather, when insect’s activity increases.

Conclusion:

In conclusion, there are effective alternatives to pesticides for controlling pests in stored organic grains. These include biological control, diatomaceous earth, carbon dioxide fumigation, temperature control, and monitoring. Integrating these preventive and intervention techniques can help to lessen pest issues with stored organic grains. Before

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implementing new procedures or utilising novel ingredients, always verify with your organic certifying organisation.