Pesticide Residue an Important Issue

Although wheat moves rapidly through the grain marketing channels in the United States, pesticides are routinely used to suppress insect populations.

Pest Management

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The level of integrated pest management (IPM) and pesticide use in stored wheat varies among wheat-growing regions in the United States. This is related to:

- Environmental conditions existing in these various regions.
- Different insect species associated with wheat in different wheat-growing regions.
- Susceptibility of different wheat classes to insects.
- Time wheat is in storage.

Studies published by Purdue University in 1997 found that 39% of the 293 elevator managers surveyed fumigated their stored wheat with phosphine.

Generally, wheat stored at elevators is fumigated with phosphine. About 50% of wheat stored on farms is treated with malathion and chlorpyrifos-methyl (Reldan).

A 1997 U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) survey provided a more accurate picture of pesticides used on wheat in the U.S. marketing system, because it was based on the percent of stored wheat that was treated as opposed to percent of elevator managers making the treatment.

The NASS survey data was based on 1,956 reports from 14 states and represented 82% of U.S. wheat production (3.6 billion bushels). The survey showed that only 15% of the wheat was treated with pesticides, and the amount of pesticides applied was 175,300 pounds – a small amount compared with amounts of pesticides used on field crops. A total of six pesticides were reportedly used on the wheat.

Approximately 11.5% of wheat stored at elevators was fumigated with phosphine; 1.5% was treated with malathion; 1.4% was treated with chlorpyrifos-methyl; 0.4% was treated with methyl bromide; 0.2% was treated with diatomaceous earth; and 0.02% was treated with lindane (as a seed treatment).

The results show that only a fraction of the wheat stored at U.S. elevators is treated with pesticides, mainly with phosphine, which does not have any residual activity.

Pesticide Residues

The NASS survey clearly showed that non-residual pesticides, such as phosphine, are used on U.S. wheat stored at elevators.

However, surveys by USDA under the Pesticide Data Program (PDP) revealed that residues of malathion and chlorpyrifos-methyl are found in wheat samples collected by Grain Inspection, Packers, and Stockyards Administration (GIPSA) personnel at elevators.

In 1995, 600 wheat samples from 29 states were analyzed for multiple pesticide residues. Malathion residues were detected in 71% of the samples, and chlorpyrifos-methyl residues were detected in 54.2% of the samples.

In 1% of the samples, residues of methoxychlor, registered for use on empty grain-holding facilities, was detected. The amount of residues of malathion, chlorpyrifos-methyl, and methoxychlor found in samples ranged from 0.002-2.9 ppm, 0.002-3.3 ppm, and 0.013-0.13 ppm, respectively.

The established tolerance levels of these pesticides allowed on grain are 8 ppm for malathion, 6 ppm for chlorpyrifos-methyl, and 2 ppm for methoxychlor.

In 1996, 340 wheat samples collected from 27 states were analyzed. Malathion, chlorpyrifos-methyl, and methoxychlor residues were found in 70.3%, 73.2%, and 4.7% of the samples, respectively.

The residue levels found ranged from 0.005 to 1 ppm for malathion, 0.002 to 1.5 ppm for chlorpyrifos-methyl, and 0.012 to 0.064 ppm for methoxychlor.

In 1997, 623 samples from 29 states were analyzed for residues. Malathion residues (0.005 to 7.6 ppm) were detected in 68.2% of the samples; chlorpyrifos-methyl residues (0.002 to 1.8 ppm) were detected in 55.6% of 622 samples; and methoxychlor residues (0.012 to 0.73 ppm) were detected in 5.2% of 617 samples.

Surprisingly, in 3.7% of the samples, violative residues (0.003 ppm) of pirimiphos-methyl were detected. A tolerance level for pirimiphos-methyl on wheat has not been established in the United States, but the international CODEX tolerance is 10 ppm. Pirimiphos-methyl is not registered for direct treatment of wheat in the U.S.

It is interesting to note that 40 to 48% of the samples had residues of both malathion and chlorpyrifos-methyl.

Considering the fact that very little wheat is treated with grain protectants at commercial elevators, the presence of malathion and chlorpyrifos-methyl residues in a large number of wheat samples can be explained by two reasons: (1) treatment of wheat at the farm level or prior to sale at the elevators, and (2) blending of treated with untreated wheat, resulting in the presence of residues well below tolerance levels.

Grain protectants should be applied only once to the grain, because of the risk of exceeding the tolerance limits. However, as grain is marketed, it is unclear whether treated grain gets re-treated at various points in the marketing channel. It is also unclear whether grain is routinely tested for pesticide residues at the time of sale. Other suggested practices include segregating treated and untreated grain and managing infestations in untreated grain with phosphine.

Current Pesticide Options

The pyrethroid cyfluthrin (Tempo) is not registered for direct treatment of grain, but it is labeled for treating empty grain-holding facilities intended for storage of various commodities.

Several diatomaceous earth formulations are also suitable for treating empty

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storage facilities. Although, synergized pyrethrins (natural pyrethrins plus the synergist piperonyl butoxide) have been labeled for treating empty facilities, this product has been rarely used by farmers or elevator managers. The reasons for the unpopularity of synergized pyrethrins is unclear, but it may be related to cost, effectiveness, and availability.

In 2002, Storicide, a combination product containing 3 ppm chlorpyrifos-methyl + 2 ppm cyfluthrin, was registered for direct treatment of grain. It is unclear whether this product was widely used in 2003 by wheat producers and elevator managers. There are no international tolerances, so the primary market may be for seed treatments only. This product soon may be replaced by Storicide II, a product containing 3 ppm chlorpyrifos-methyl + 0.5 ppm of a pyrethroid, deltamethrin. Registration for direct application to raw stored wheat and other grains is anticipated in 2004.

The insect growth regulator, Methoprene (Diacon II), which does not kill adults but affects the growth and development of immatures, was registered recently for direct treatment of grain. It is a viable product, especially for treating grain intended for long-term storage (six months to a year).

Several enhanced diatomaceous earth formulations (Dryacide® or Protect-It®) are labeled for direct treatment of grain. However, it is important to realize that when using these products, only a portion of the grain should be treated, so that adverse effects on grain flowability and test weight are minimized. Furthermore, these formulations may not be suitable for use on high-moisture wheat or wheat stored in humid climates.

Phosphine in both tablet/pellet form and as a gas (ECO_2FUME) can be used for grain treatment. Fumigants should not be used as a prophylactic treatment but used only to manage an existing infestation.

Products for the Future

Spinosad, a commercial bacterial pesticide, has been tested in laboratory and field conditions on stored wheat. It is effective at low rates (1 ppm) on a range of stored-product insects, especially against the lesser grain borer. Registration for direct treatment of wheat and other grains is expected in 2004. Storicide II is another product that may obtain registration next year.

Pirimiphos-methyl, presently registered for use on stored corn and sorghum, is being considered as a potential grain protectant for stored wheat. Research has shown this product to be effective on wheat against a range of stored-product insects. However, resistance to this product has been documented in a few species, especially in the hairy fungus beetle.

Pesticides should be used as a supplement and not as a substitute to a well-designed IPM program. A good IPM program is based on sanitation of storage facilities and grain; application of a grain protectant; monitoring of insects, temperature and moisture in stored grain; use of aeration; and fumigation with phosphine as needed.

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