

# Reducing Mosquito Breeding Sites When Using Waste Tires as Anchors for Bunk Silo Covers



## Introduction

Horizontal or bunk silos are economical, large-capacity forage storage structures that are well suited to large dairies and beef operations. The need for large-capacity forage storage structures increases on many dairy farms as the herd size increases, so these structures are likely to become more common in Pennsylvania. The extensive surface area of bunk silos and the relatively shallow depth of the forage in them mean that a large amount of the harvested crop is at risk for potential loss if it is not well packed and adequately protected.

This fact sheet describes the importance of covering bunk silos and anchoring the cover well, explains the role of mosquitoes in the transmission of West Nile virus, and suggests options to reduce the potential mosquito breeding sites in waste tires.

## Covering Bunk Silos

Management of the silage-making process dramatically influences the amount and value of the silage coming out of storage. Silage dry matter is lost when there is excessive plant respiration, oxidation, and bacterial breakdown of the crop after it is harvested and before it is fully stabilized by fermentation. In addition, aerobic bacteria, yeasts, and molds will continue to proliferate in an open or uncovered silo, breaking down the plant materials and producing gaseous and heat losses. The resulting fermentation end products have much lower nutritional value than those in properly fermented silage.

One of the principal management practices to reduce undesirable silage losses is covering a bunker silo after filling. Silage dry matter losses and spoilage are greatest on the surface and diminish with depth into the silage depending on the type of crop material, crop dry matter at harvest, density of crop packing in the silo, and the weather conditions following silage making. Spoilage and dry matter losses in an uncovered bunk silo may reach up to 30 percent for the top 3 feet of the silage depending how well the crop is packed. The most dramatic losses, as great as 50 percent of the dry matter and 100 percent of the digestibility, occur at the silage surface and in the first 20 inches of silage below the surface. With these losses, almost 1 ton of silage is lost for every 100 square feet of bunk surface area. For a 4,000-square-foot silo, this means 40 tons is lost each time it is filled. Precipitation that penetrates and/or runs off the exposed silage removes the most valuable silage components, which are the water-soluble

carbohydrates and nitrogen fractions. These losses decrease the value of the silage, create feedout problems when the spoiled forage is handled separately, and can degrade water quality around the silo. Silage that has been exposed in the silo is often less palatable for animals, so they eat less and leave behind more refused feed. Also, the feed may have shorter bunk life, decreasing animal intake, creating waste, and adding to feed handling problems.

Sealing the exposed surface of a bunk silo is an important management practice in producing high-quality silage. Covering bunk silos with a 4 to 9 mil (1 mil = 0.001 inch) plastic with ultraviolet light protection and anchoring the cover with waste tires has been a common practice (Figure 1). The key to reducing the seepage of air under the plastic is to adequately anchor it. This means putting enough tires on the surface to keep air out. As the number of tires increases up to about 25 per 100 square feet of surface area—when passenger car tires are essentially tread-to-tread in a single layer—silage losses tend to decrease. Adequately anchoring the edges of the cover is essential, too. Sand bags, soil, or other heavy materials that conform well to the surface contours at the edges are useful.

Full-casing waste tires have been the standard for anchoring bunk silo covers for years, but they have some drawbacks. They are heavy to move and bulky to store. A full-casing tire can weigh from 20 to 60 pounds or more depending on the size and tire construction. Because they hold water, handling them can be messy and cumbersome with the added weight. Full-casing weights can be 40 to 70 percent heavier when they are holding water than when they are empty. Standing

**Figure 1. Bunk silo cover anchored with waste tires.**



water in a full-casing tire is also a great breeding ground for mosquitoes. With the increasing awareness and spread of West Nile virus by mosquitoes, there is another reason to avoid the problems created by using full-casing tires around the farm.

## West Nile Virus

West Nile virus (WNV) can cause encephalitis, an inflammation of the brain and spinal cord. The first WNV outbreak in the United States occurred in the New York City metropolitan area in August 1999 when 62 people were diagnosed with the disease, and 7 of those people died. Most people who are infected with the WNV will not have any type of illness or only mild symptoms. Those over 50 years of age have the highest risk for severe disease. Also in 1999, many horses, a variety of zoo birds, and several thousand crows were infected with WNV.

West Nile virus is transmitted by mosquitoes that become infected after biting infected wild birds—the primary hosts of the virus. The virus circulates and multiplies for several days in a mosquito's blood before entering the salivary glands. After an incubation period of 10 to 14 days, an infected

mosquito can transmit WNV to both humans and animals while feeding on them. In 2002, 62 Pennsylvanians were diagnosed with WNV and 9 deaths were attributed to the disease. The average age of the victims was 81 years old.

When a bird is bitten by an infected mosquito, it becomes a carrier of the virus that may be transferred to another mosquito for up to 5 days. Most birds do not die from the virus; they simply contribute to the spread of the disease. The rapid spread of WNV across Pennsylvania can be attributed to the flight of infected birds and the subsequent feeding on them by other mosquitoes.

The Commonwealth of Pennsylvania is encouraging citizens to report dead and dying crows, blue jays, and raptors (hawks and owls) so the birds can be tested for WNV or entered into a database for tracking purposes. More than 17 species of birds have been identified with the virus in Pennsylvania.

Until recently, mosquitoes were considered little more than a nuisance. With the occurrence of WNV in Pennsylvania, controlling the primary vectors of WN — *Culex* and *Adex* spp. of mosquitoes—and in particular, the northern house mosquito (*Culex pipens*) is important. Eliminating potential breeding sites of these mosquitoes is an effective disease prevention tool for homeowners and farm managers to reduce the risk and spread of WNV.

## Mosquito Life Cycle on Farms

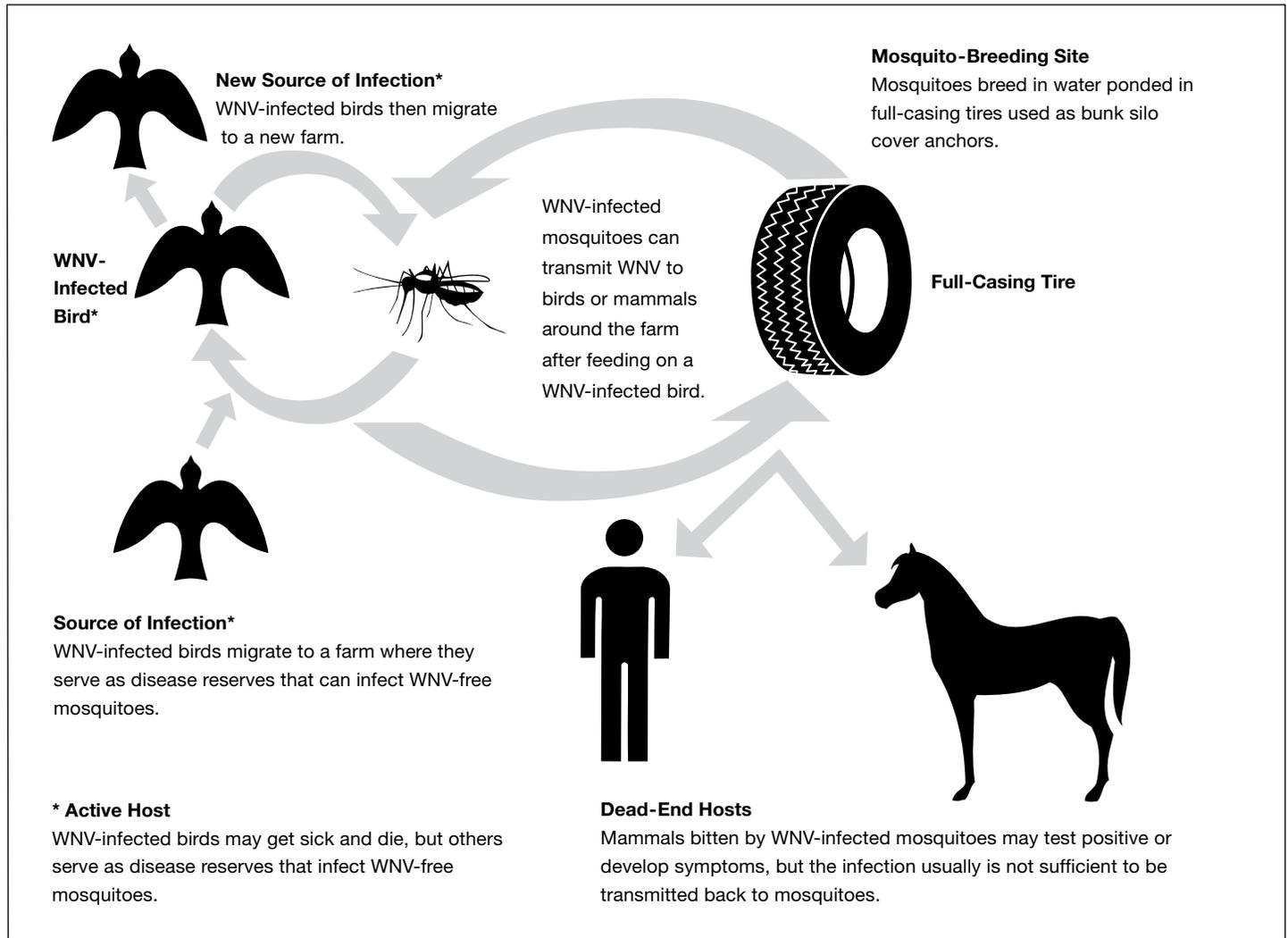
Mosquitoes can find many suitable spots for breeding on farms. The larvae of the northern house mosquito, the most commonly encountered mosquito in Pennsylvania, prefer stagnant, polluted waters containing organic matter such as manure, urine, and leaves. A favorite breeding place around many farms is the water collected in full-casing tires used to anchor bunk silo covers.

Mosquito reproduction begins when an adult female mosquito lays a raft of eggs on standing water. The eggs hatch into larvae, living on nutrients and other organisms in the water. They require air, so they wriggle or twist while rising to the water surface to breathe. That's why in this stage they are known as "wigglers." As the larvae mature, they begin to develop wings while still living underwater, and are called pupae. After 4 to 10 days, they emerge as adults and take flight. Reproduction will continue as long as the weather is warm and water can be found that is deep enough to

support life. The typical breeding season in Pennsylvania is from late April until around mid-September. Ideal water depths for breeding are from 2 to 8 inches.

Meanwhile, birds that are bitten by adult mosquitoes infected with WNV can also pass on the virus to the next adult mosquitoes that bite them. With the high density of birds and many potential mosquito breeding sites, farms can be significant sources of WNV infection and play important roles in the spread of WNV (Figure 2).

**Figure 2. Introduction and transmission of West Nile virus by mosquitoes breeding in full-casing tires.**



## Making Tires Mosquito-Resistant

There are several ways to combat mosquito breeding in the full-casing tires used to anchor bunk silo covers. The best actions to make tires mosquito-resistant, and the trade-offs with each action are often influenced by the construction of the tires used. The two common types of tires available are bias-ply and radial-ply (Figure 3).

### Bias-ply:

These tires are made of layers of textile cords, typically nylon, overlaid at approximately 30° angles and wrapped around the bead wires, which anchor the tire to the rim, and then encased in rubber, to form the casing or air chamber. The tread pattern is formed by adding more rubber to the overlaid plies.

### Radial-ply:

A single layer of steel wires, encased in rubber, arch from one bead to the other to form the casing for these tires. Numerous steel belts are placed on the crown of the casing and encased with rubber to form a strong stabilizing unit. The tread pattern is formed by adding more rubber to this layer of steel belts.

## Options for Using the Full-Casing Tires on Hand

### 1. Leave tires on rims.

This will keep the water out but makes handling cumbersome and more difficult with the extra weight. It will not be practical for many tire and wheel combinations or when a large number are needed.

### 2. Drill holes in tire sidewalls.

Drilling several holes in each sidewall to eliminate the possibility of water ponding more than 1 inch deep is quite a task, especially in radial-ply casings. A bench or portable ½-inch electric drill with a 1 inch or larger carbide hole saw can work, but it will take quite some time to do just one tire. Also, the bit sometimes snags the steel cords, leaving sharps that can rip fingers and plastic silo covers. Holes drilled smaller than 1 inch in diameter are usually not effective because they will easily plug with leaves or other debris.

### 3. Cut tires in half.

Tire cutting machines can slice through the center of the tread around the outside of the tire leaving two circular halves. These sections still have the potential to retain water, although the water generally will be inadequate

for mosquito breeding. When radial-ply tires are cut, fine wires protruding from the cut edge can puncture or rip bunk silo covers, so they must be used carefully.

### 4. Remove tire sidewalls.

Tire bead cutters can remove the tread and leave behind much of the sidewall and the bead. Much of the weight is lost, so adequate anchoring of a bunk silo cover can require more than a single layer of sidewall disks. Also, the remaining tread section can still hold water if not disposed of properly.

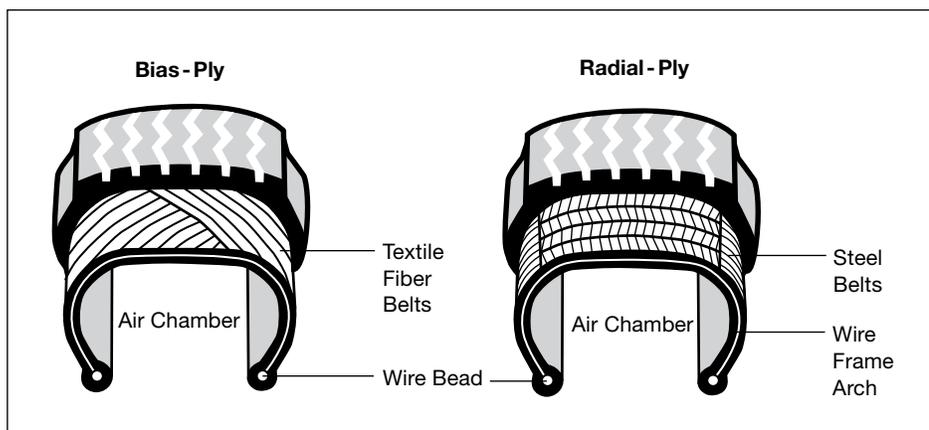
Although several manufacturers sell equipment that can cut and slice tires, locating a custom operator could be an option to purchasing this specialized equipment. Local tire shop operators may know of tire slicing services that are available.

**5. Cover unused tires.** Covering unused tires during the mosquito breeding period each summer to reduce the ponding of water in the full-casings could likewise reduce the potential breeding sites. Care will be required to avoid ponding of water in the covers that could become breeding sites. Since covering requires additional labor and materials, it may be most suitable as a transitional option until a more permanent solution is implemented. Of course, keeping only the number of tires on hand that is required to adequately anchor silo covers helps to control the mosquito breeding sites, too.

### 6. Treat tires with a mosquito larvicide.

When tires cannot be manipulated to reduce the hazard of mosquito breeding, larviciding is another control technique. Larvicides to treat water accumulating in full casing tires include *Bacillus thuringiensis israelensis* (Bti),

Figure 3. Construction details of common tires.



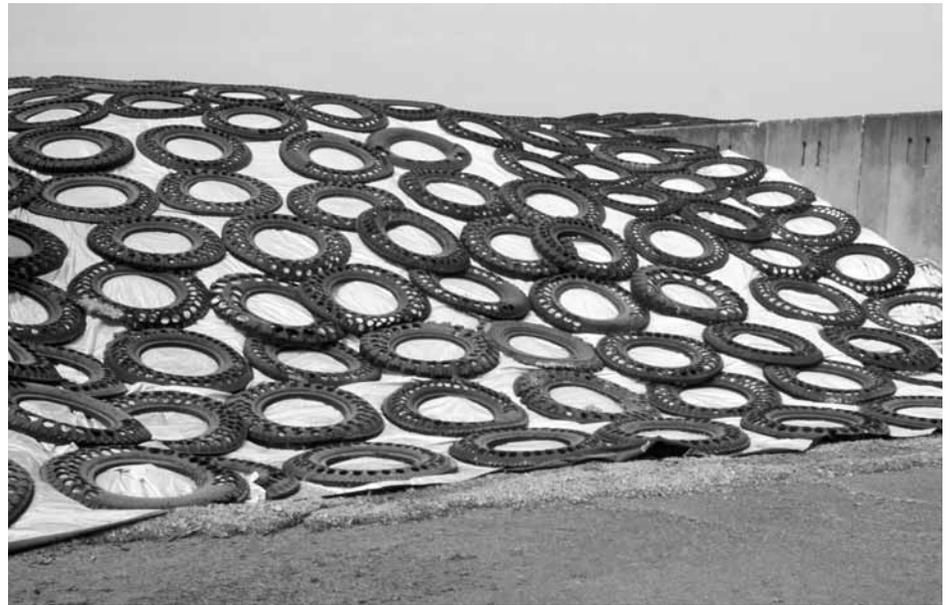
growth regulators, oils, or monomolecular films. Use of these products requires a certified pesticide applicator license for tire treatment when someone is hired to do the applications. For more information about larvicidal control, contact the local WNV county coordinator, the Pennsylvania Department of Environmental Protection (DEP), or the Pennsylvania Department of Agriculture.

## Alternatives to Using the Existing Full-Casing Tires

### 1. Replace with sidewall disks.

Full sidewall disks, often with some tread remaining, are available with or without a lacework of holes in the sidewalls (Figure 4). Most of the tires used to create these sidewall disks are bias-ply truck tires because the steel cables and belts in radial-ply tires make the cutting more difficult. As radial-ply truck tires are being used more frequently, the heavy duty bias-ply tires are becoming less available. A bias-ply truck tire sidewall disk with a 40 inch diameter and holes will weigh around 30 pounds. These disks are often leftover scraps when sections of the sidewall have been removed for other manufacturing purposes. Although the weight of the disks will be less when the holes are punched than if they were not, the cost of full disks without the holes may be higher than the scrap disks with the holes. The sidewall disks do not hold enough water for mosquitoes to breed and are lighter and cleaner to handle than the full-casings. The lighter weight of the sidewall disks compared to full-casings can lead to ineffective anchoring of bunk silo covers if not enough disks are used. Full-casing tires that are placed tread-to-tread often provide between 5 and 6 pounds per square foot anchoring weight for the silo cover, while the perforated sidewalls at

Figure 4. Bunk silo cover anchored with sidewall disks.



the same density can provide only half as much weight. Having an adequate number of sidewall disks will be even more important than when full-casing tires are used (Figure 5). Some experience may be necessary to determine an adequate number of sidewalls to adequately anchor a particular bunk silo cover. If the larger truck tire sidewall disks are used to replace passenger car full casing tires, the number of disks to handle will be less than for the car tires reducing the time to anchor the bunk silo cover. Also, the sidewalls can be readily stacked and, if placed on pallets, they can be easily moved and even lifted up to the bunk wall level when the silo is being covered and uncovered (Figure 6).

### 2. Use heavy equipment tire beads.

Some manufacturers of agricultural products made from large agricultural or earthmoving equipment tires remove the rigid steel bead portion of the tires. These beads range from 2 to 4 feet in diameter and weigh between 25 and 75 pounds, so they can be difficult to handle compared to other alternatives. Since the beads come from bias-ply tires, there are no wires to injure hands or to snag plastic silo covers.

### 3. Select options to tires.

Many options to anchor bunk silo covers, and even to covers themselves, have been proposed and tested. However, few have been as successful or as widely accepted as waste tires. The options to full-casing tires described in this fact sheet may be among the most practical means currently available to ensure quality silage while reducing the potential hazard of mosquito breeding sites.

Figure 5. Close-ups of sidewall disks on a bunk silo cover.



Figure 6. Storing sidewall disks used to anchor a bunk silo cover on pallets.



## Disposal of an Old Supply of Tires

When replacing a supply of full-casing tires, the full casings should be disposed of properly. Tires that have outlived their usefulness are difficult to manage. More than three billion scrap tires are known to exist in stockpiles—legally or illegally—in the United States. The national scrap tire inventory is increasing at a rate of 200 to 250 million per year, which amounts to about one tire per person per year. Some municipal solid waste authorities offer special services, including tire drives to round up used tires. Local tire shop operators can also be sources of information for local programs. It is important to utilize a reliable disposal service, not some fly-by-night operation where the tires might end up in an unapproved location only to become mosquito breeding grounds in a new place. Be sure to ask to see a current tire hauler authorization from the DEP before consenting to a disposal agreement. For more information on locating authorized tire haulers, see the DEP Waste Tire Program Web site in the Sources of Information section of this fact sheet or contact the nearest regional DEP office.

## Sources of Information

### Waste Tires

#### Pennsylvania Department of Environmental Protection Waste Tire Program

Information on licensed tire haulers, waste tire processing centers serving Pennsylvania, and other related facts about scrap tires is available at the DEP waste tire program Web site:

[www.dep.state.pa.us/dep/deputate/airwaste/wm/MRW/Tires/Tires.htm](http://www.dep.state.pa.us/dep/deputate/airwaste/wm/MRW/Tires/Tires.htm).

## Local Telephone Commercial Directory

Check for listings under "Tire Retreading and Repairing" or "Recycling." There are only a few tire recycling sites in Pennsylvania where tires are processed into other products such as cow mats, doormats, etc.

## Local Recycling Coordinator

The recycling coordinator for each county in Pennsylvania who may have information on local options. The Pennsylvania Department of Environmental Protection (DEP) maintains a Web site listing all county recycling coordinators: [www.dep.state.pa.us/dep/deputate/airwaste/wm/recycle/document/countymaplinked.html](http://www.dep.state.pa.us/dep/deputate/airwaste/wm/recycle/document/countymaplinked.html).

## Rubber Manufacturers Association

This organization has information on scrap tires and tire management: [www.rma.org/scraptires/scraptires.html](http://www.rma.org/scraptires/scraptires.html).

## West Nile Virus

### Centers for Disease Control and Prevention, U.S. Department of Health and Human Services

A wide range of materials on practically all aspects of the Arboviral Encephalitides diseases (including West Nile Encephalitis) is available at [www.cdc.gov/ncidod/dvbid/arbor](http://www.cdc.gov/ncidod/dvbid/arbor).

### Pennsylvania Department of Agriculture

Provides general information for horse owners, farmers, and others about West Nile virus in Pennsylvania: [www.agriculture.state.pa.us/agriculture/cwp](http://www.agriculture.state.pa.us/agriculture/cwp).

### Pennsylvania Department of Health

Hosts the Pennsylvania West Nile Virus Surveillance Program with general information and updates on the status of WNV in Pennsylvania: [www.westnile.state.pa.us](http://www.westnile.state.pa.us).

## Pesticide Education Office, The Pennsylvania State University

General information, fact sheets, presentations, and links to other resources on West Nile Encephalitis: [www.pested.psu.edu/issues/wnv/](http://www.pested.psu.edu/issues/wnv/).

## Local County Health Department

Some county health departments have designated West Nile virus coordinators. Check with your local county government to find out who is responsible.

## Regional DEP Offices ([www.dep.state.pa.us/dep/deputate/fieldops](http://www.dep.state.pa.us/dep/deputate/fieldops)):

### Northwest Region

230 Chestnut St.  
Meadville, PA, 16335  
814-332-6945

### Northcentral Region

208 West Third Street, Suite 101  
Williamsport, PA 17701-6448  
570-327-3695

### Northeast Region

2 Public Square  
Wilkes-Barre, PA 18711-0790  
570-826-2511

### Southwest Region

400 Waterfront Dr.  
Pittsburgh, PA 15222-4745  
412-442-4192

### Southcentral Region

909 Elmerton Ave.  
Harrisburg, PA 17110  
717-705-4704

### Southeast Region

Lee Park, Suite 6010, 555 North Lane  
Conshohocken, PA 19428  
610-832-6012

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