



# WEST NILE VIRUS

Protect Your Horses from West Nile Virus (Home Garden Series)

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# West Nile Virus

## Introduction

West Nile Virus (WNV) is one of the most important mosquito-vector diseases of horses in North America and worldwide (Chancy et al. 2015). There are a number of other biting insects that attack horses, but only a few species of mosquitoes are efficient vectors of this serious disease.

According to the American Association of Equine Practitioners (AAEP), more than 25,000 cases of equine encephalitis can be attributed to WNV since it was first detected in the United States in 1999. Risk of sickness and death from WNV and other mosquito-borne equine encephalitis viruses are greatly reduced by proper vaccination and mosquito control efforts.

Similar to the longer-recognized Eastern, Western, and Venezuelan encephalitis viruses that can occasionally affect humans and equines, West Nile Virus is spread by the feeding activity of adult female mosquitoes.

Wild birds are the natural reservoir for WNV. Mosquitoes take blood containing the virus from infected birds and maintain the virus in their salivary glands. They inject the virus into the next bird, human, or horse host when they feed again.

–Castillo-Olivares & Wood (2004)

Signs of illness can first appear from a few days to two weeks after infection with the virus. About 10% to 40% of infected horses actually become ill (Iowa State University 2013); most show no signs of having been infected with the virus. Of those that progress to show signs of illness, 30% to 40% die (Iowa State University 2013).

The West Nile Virus causes *encephalomyelitis*, or inflammation of the brain and spinal cord.

## History of WNV in the U.S. and Washington

The WNV was first detected in the West Nile region of Uganda in 1937. It was identified in the U.S. in New York State in 1999 and in Washington State in 2002. As of 2012, the virus had been detected in 65 different mosquito species in the U.S.

Some of these mosquitoes overwinter as adults and even feed all winter in more temperate areas of the continent. This perpetuates virus numbers in host birds and increases the likelihood of geographic spread via migrating bird species (Granwehr et al. 2004).

The WNV is present throughout North America and expected to remain endemic in most of the western hemisphere (Murray, Mertens, and Desprès 2010). Numbers of cases of WNV confirmed in Washington State horses between 2002 and 2015 is depicted in Figure 1.

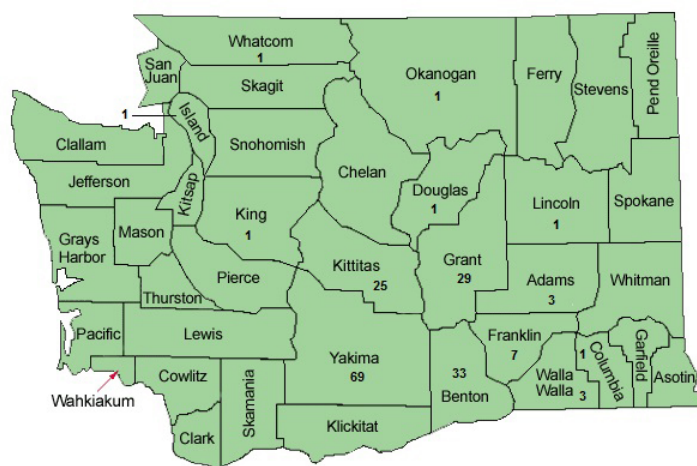


Figure 1. Accumulation of county reports for positive horse cases of WNV in Washington State from 2002 to 2015. Data courtesy Washington State Department of Health.

## Key Role of Mosquitoes

Mosquitoes are considered aquatic or semi-aquatic insects and rely on standing water to complete their development. Adult mosquitoes lay eggs in or near water. Some species only lay eggs on top of standing water, while other species lay eggs along the edges of flood plains.

Mosquito eggs hatch into larvae, which are aquatic and need standing water to filter-feed on organic debris in the water (Figure 2). Mosquito larvae have a characteristic breathing tube. When startled, larvae wiggle away from the water's surface to seek protection in deeper water.



Figure 2. Larvae of mosquitoes suspended in pond water. Photo by T. Murray.

Larvae then pupate in the water until the adult is ready to emerge. Pupae are often referred to as “tumbler,” due to their characteristic movement when startled (Figure 3).



Figure 3. Pupa of a mosquito in the foreground with the larvae in the background. Photo by T. Murray.

Each mosquito species has variations in its preferred habitat. Some species like pond edges, brackish water, or small water-filled containers. The species and temperature determine how long development from egg to adult takes, but some species can develop into adults in as little as four days.

## Signs of Illness

Signs of WNV illness in affected horses can include and progress from fever, depression, poor appetite, behavior changes, and muscle tremors/twitches to heightened response to stimuli, poor vision, stumbling, incoordination, weakness, paralysis, compulsive wandering, head pressing, difficulty swallowing, seizures, coma, and death. Death can even occur with no prior signs. Of the horses that become ill, yet survive, 10% to 20% will be left with some permanent changes (Iowa State University 2013).

Several other serious diseases can cause these same signs, so a veterinarian should be contacted promptly for correct diagnosis and best treatment outcome if horses appear ill. The diagnosis for WNV is made via blood tests.

## Protect Horses

The best approach to prevent this disease in horses is a concerted one: protect them with vaccinations, actively monitor for mosquitoes, reduce mosquito habitat, and use insecticides/repellents only when necessary.

Animal blood provides the protein needed by female mosquitoes to produce eggs. Although different mosquito species can feed on different animal blood, most species prefer a group of animals, such as birds (Figure 4).

Most mosquito species, including the most serious vectors of WNV, feed primarily between dusk and dawn. Some species commonly feed during the day.

Watch for mosquito activity on your horse property, including pastures and housing facilities, from dawn to dusk. Look for adult mosquitoes feeding on your horse(s) and even yourself as you walk your property during the different times of day.

## West Nile Virus Transmission Cycle

In nature, West Nile virus cycles between mosquitoes (especially *Culex* species) and birds. Some infected birds can develop high levels of the virus in their bloodstream and mosquitoes can become infected by biting these infected birds. After about a week, infected mosquitoes can pass the virus to more birds when they bite.

Mosquitoes with West Nile virus also bite and infect people, horses, and other mammals. However, humans, horses, and other mammals are “dead end” hosts. This means they do not develop high levels of virus in their bloodstream and cannot pass the virus on to other biting mosquitoes.

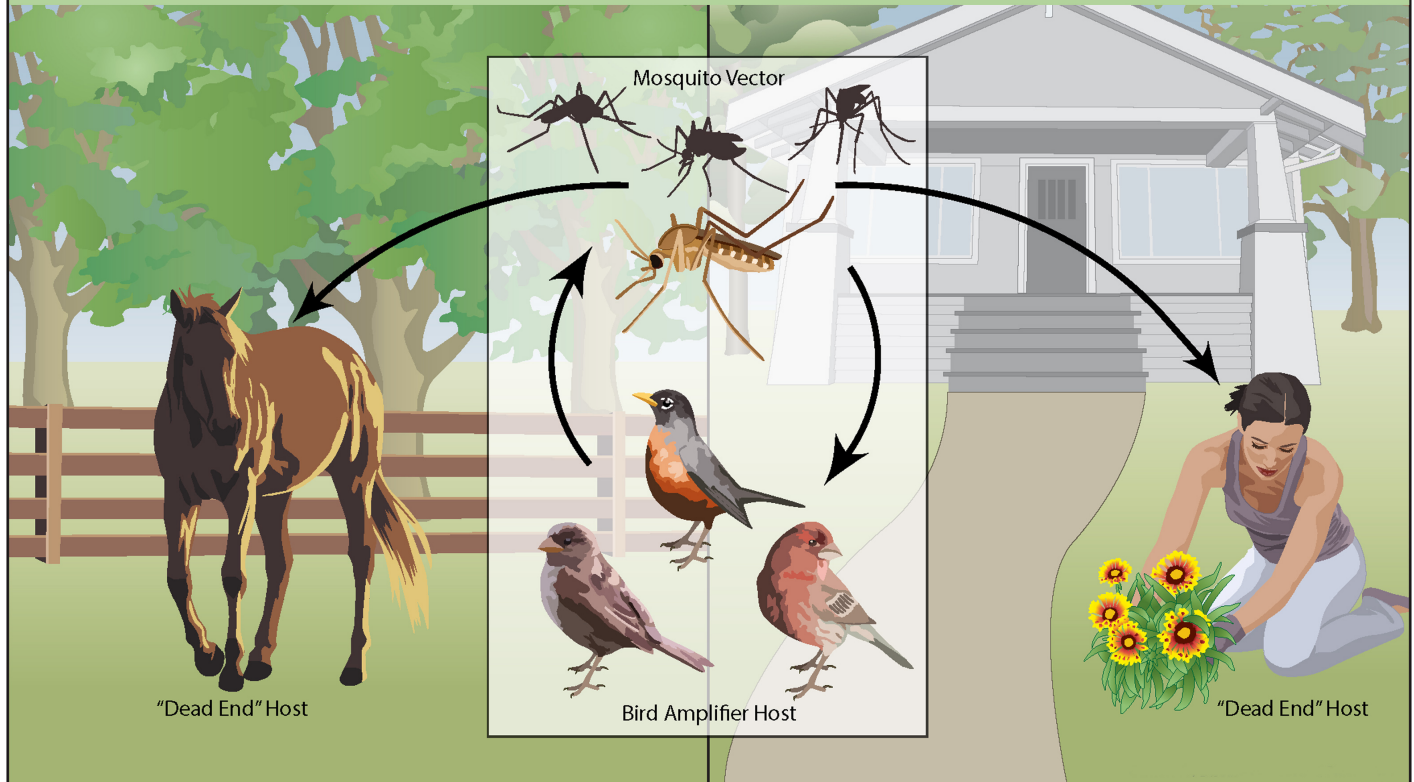


Figure 4. The disease cycle for the mosquito-vectored West Nile Virus. Diagram adapted from the U.S. Centers for Disease Control and Prevention.

Use the following preventative methods for protecting horses:

- Consult a veterinarian about which WNV vaccine to use and when. There are several vaccines available; each requires an initial series of two vaccinations with an annual booster before the start of mosquito season. More information is available on the AAEP web site at [aaep.org](http://aaep.org).
- Remember to give a booster vaccination to horses annually well before mosquito season. It may take up to four weeks for the vaccine to be fully protective. The onset of mosquito season varies year-to-year depending on temperature and rainfall. In general, plan on mosquito season start dates of April 1 in coastal areas and May 1 elsewhere in Washington State. Owners of horses being vaccinated for the first time will need to plan ahead so the second vaccination in the series can occur one month before mosquito season starts.
- Keep horses inside, in screened, mosquito-resistant stalls or barns between dusk and dawn, when mosquitoes are most active. Watch for adult mosquitoes in enclosures and, if found, treat those areas with an approved and effective insecticide registered for use on adult mosquitoes. Preventative applications of insecticides are not recommended if mosquitoes are not present in stables. Read and follow product labels. Pesticide applicators must wear appropriate personal protective clothing. Do not spray when horses or other animals are stabled.
- Mosquitoes do not like wind, so using fans inside stables will reduce mosquito activity in those areas. Mosquitoes are somewhat attracted to lights, so reducing nighttime lighting in and around stables will reduce mosquito numbers in the area.

- Do not attract wild birds (especially sparrows, jays, robins, and crows) to stables. Wild birds are the natural reservoir for the virus (Komar in Castillo-Olivares and Wood 2004), which is picked up by mosquitoes when they feed on infected wild birds. Move bird feeders and bird baths away from stables. Protect horses' grain from birds. Either close barn doors at dusk or use bird netting to discourage roosting.
- Topical mosquito repellents labeled for horses are an effective tool. Always read and follow label directions when using these products, especially on foals. Contact a veterinarian if you have any questions about appropriate uses.
- Electronic devices that emit high frequency sounds do not repel mosquitoes or other pests. Electronic "bug zappers" work indiscriminately, killing many beneficial insects and relatively few mosquitoes. Do not use them.
- Carbon-dioxide-baited traps capture many adult mosquitoes, but can be expensive to purchase and operate. They will not protect horses from all mosquitoes.

## Reduce Mosquito Habitat

All mosquitoes breed in standing water. Managing water sources is an important step in reducing local mosquito populations. Identify potential sources of mosquito habitat and exclude mosquitoes from gaining access to these sources.

Eliminate standing water in containers and landscape areas.

- Survey horse pastures and housing facilities carefully and eliminate unnecessary water-holding containers that can harbor mosquitoes. Recycle or properly dispose of cans, old buckets, tires, or other water-holding objects.
- Cover unmounted tires so they don't collect water and become breeding sites.
- Mosquito-proof cisterns, fire barrels, rain barrels, tubs, septic tanks, and other water collectors with tight-fitting screens or covers to prevent adult mosquitoes from laying eggs in them.
- Eliminate non-wetland seepage ponds and persistent puddles by filling in or draining.
- Low-lying areas should be graded or filled to prevent standing water.
- Check and repair leaky irrigation systems, pipes, and faucets.
- To avoid puddles and save water, do not over-irrigate lawns and gardens.

Regularly drain or manage water-holding containers and non-wetland bodies of water.

- Empty and clean water troughs, animal dishes, wading pools, and unscreened rain barrels at least every week during warm summer months when mosquitoes can develop quickly. Drill drainage holes in the bottom of any large outdoor containers that could collect stagnant water.
- Alternatively, biological control products containing *Bacillus thuringiensis israelensis* (Bti) are available to prevent the development of young mosquito larvae into adults. These can also be used in non-drainable standing water such as koi ponds. Although Bti is a biological control, it is registered as a pesticide and must be used accordingly.
- Inspect and clean roof gutters on a regular basis. Repair any that sag to prevent standing water and at rainspout bases.
- Watch for standing water on plastic covers and tarps used outside and drain if found.
- Store wheelbarrows and buckets upside down or inside shelters so they do not fill with water and become mosquito breeding sites.
- Mow tall grass and shorten other dense vegetation around water. Adult mosquitoes are attracted to dense, tall vegetation.
- Remove unnecessary floating structures and other floating material from ponds. Those items are attractive to mosquito larvae and adults.
- Keep drains, ditches, and culverts clean and in good repair. Provide a good gradient for proper drainage.
- Maintain chlorination on unused pools and do not let water accumulate on covers.
- Consider aerating ornamental or permanent ponds that have no outlets and/or stocking with insect-eating fish, such as goldfish. Be aware they are detrimental to native non-target organisms like amphibians. They work very well in watering troughs.
- Design ponds so they have steep slopes. Mosquitoes and their larvae prefer shallow pond edges.
- Design rain gardens to drain within 48 hours after a rain event so mosquito habitat is not created.

## Use Pesticides to Control Mosquitoes as a Last Resort

Multi-pronged approaches are required for successful mosquito management. An Integrated Pest Management approach utilizing multiple approaches (habitat manipulation plus chemical strategies targeting different mosquito life stages) is instrumental for successful mosquito management. Reliance solely on the use of insecticides to kill mosquito larvae will not work. Use insecticides only in concert with habitat management.

When using insecticides registered for adult mosquito control, look for products that are labeled for mosquitoes and allowed for use inside horse facilities. Always read and follow the label directions.

Due to concerns about pesticide contamination, many restrictions apply to insecticide use around water in Washington State. For use in contained water bodies, Washington State homeowners only have a few pesticides available. Other registered products require a valid Washington State Department of Agriculture pesticide license and aquatic endorsement. See the [WSU Pestsense Database](#) for a list of products to determine which is best for specific circumstances.

Chemical management of mosquitoes is rarely effective when done by individual landowners. Effective management for a serious area-wide mosquito infestation is likely to require a regional/municipal effort. Contact your local government for mosquito abatement information. Bear in mind that controlling mosquitoes to protect your horse's health will also reduce the risk of WNV disease for humans.

## Further Reading

Parker, R., and C. Black. 2014. [Aquatic Pest Control](#). *Washington State University Extension* Publication EM039.

Long, M.T. 2015. [Merck Veterinary Manual: Overview of Equine Viral Encephalomyelitis](#). Kenilworth, NJ: Merck Sharp and Dohme Co.

Municipal Research and Services Center of Washington: [Mosquito Control Districts](#).

Black, C., and G.L. Thomasson. 2014. [Public Health Pest Control](#). *Washington State University Extension* Publication EM034.

[WSU Pestsense Database Mosquito Fact Sheet](#).

United States Centers for Disease Control and Prevention. [West Nile Virus](#).

U.S. Department of Agriculture Animal and Plant Health Inspection Service. [West Nile Virus distribution maps](#).

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Castillo-Olivares, J., and J. Wood. 2004. [West Nile Virus Infection of Horses](#). *Veterinary Research*. 35(4), 467-483.

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Granwehr, B.P., K.M. Lillibridge, S. Higgs, P.W. Mason, J.F. Aronson, G.A. Campbell, and A.D.T. Barrett. 2004. [West Nile Virus: Where Are We Now?](#) *The Lancet Infectious Disease*. 4 (9), 547-556.

Iowa State University Center for Food Safety and Public Health. 2013. [West Nile Virus Infection](#). Iowa State University. Ames, IA.

Murray, K.O., E. Mertens, and P. Desprès. 2010. [West Nile Virus and Its Emergence in the United States of America](#). *Veterinary Research*. 41(6).



Use pesticides with care. Apply them only to plants, animals, or sites as listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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