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## Kansas Insect Newsletter

For Agribusinesses, Applicators, Consultants, and Extension Personnel

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# MOSQUITOES AND WEST NILE VIRUS IN KANSAS

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The range of West Nile Virus (WNV) has expanded westward. In summer 2002, WNV has been detected for the first time in Kansas and eleven other new states including Colorado, Minnesota, Nebraska, New Mexico, North Dakota, Oklahoma, South Carolina, South Dakota, Texas, West Virginia, and Wyoming. In total, since the first case in US (in New York) in 1999, West Nile virus has been reported from forty US states and four provinces in Canada (Manitoba, Saskatchewan, Ontario, Quebec). It is likely that WNV will eventually reach the West coast and will also establish in Mexico and Central America

At this writing, WNV has been reported from 50 Kansas counties from horses, wild birds, and mosquitoes but not from people.



Female mosquito (*Culex pipiens*) laying eggs.

From: CDC Website

## **VIRUS ECOLOGY**

**Birds and Mosquitoes:** WNV typically circulates between birds and mosquitoes. The mosquito female feeds on the blood of an infected bird. The virus starts to multiply in the mosquito gut and then travels to salivary glands. When the infected mosquito bites/feeds on the blood of another/non-infected bird it injects saliva with the virus to the new host (Figure 1). In some bird species (primarily crows, blue jays, and ravens) the virus can cause disease (infection of kidney and brain) often leading to a bird death. (Mosquitoes do not feed on dead birds). However, many other bird species (over 110 species including chickens) can be infected and carry the virus without becoming sick.

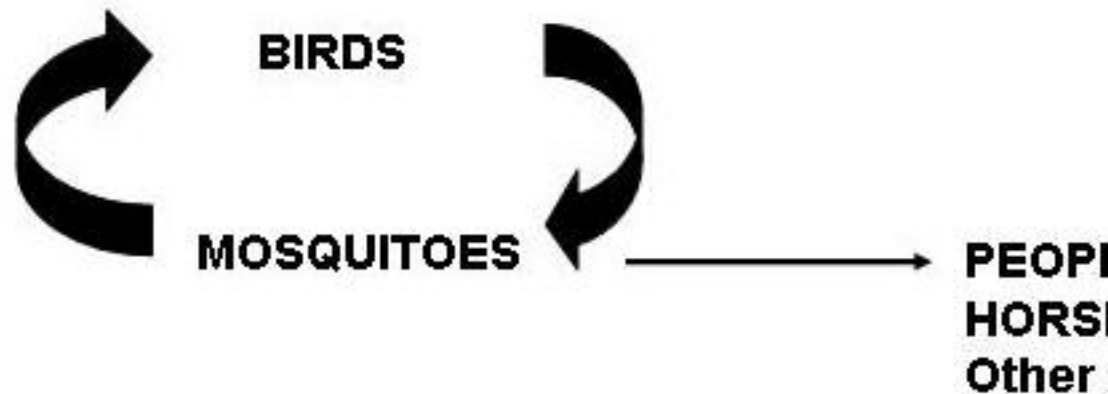
Bird-to-bird transmission is possible. Predaceous birds feeding on infected birds can become infected. Migratory birds, and international as well as regional trade (movement of goods contaminated with mosquitoes) are two most likely ways of transport of the virus to new areas.

At least 26 mosquito species have been reported to be infected with WNV. In Kansas, the primary mosquito species capable of spreading WNV belong to the genus *Culex* (*Cx. pipiens*, *Cx. tarsalis*, *Cx. salinarius*, *Cx. restuans*). See Mosquito Biology section.

**Mammals:** The only known way mammals, including horses and people, can be infected with the virus is by being bitten by an infected mosquito. Mammals are considered to be "dead end hosts" because the virus does not multiply in their bodies at levels high enough to be infective for other organisms including mosquitoes (e.g. the virus is detectable in horse blood just for a few days and there is no evidence that a mosquito feeding on the blood of an infected horse becomes infected).

Symptoms of horses infected with WNV include lack of coordination, difficulty walking, muscle twitches, head tilting, weakness and paralysis of limbs, blindness, lip droop, and in some cases death. The same symptoms are typical for other infections (e.g. Eastern and Western Equine Encephalitis and rabies). A Horse vaccine for WNV is available. Vaccines for other encephalitis do not protect horses from WNV. Contact your veterinarian for more information on the vaccine. The vaccine may not be effective for 6 weeks, therefore it may not be necessary to vaccinate at this time for the oncoming winter.

## Figure 1. Transmission cycle of West Nile Virus



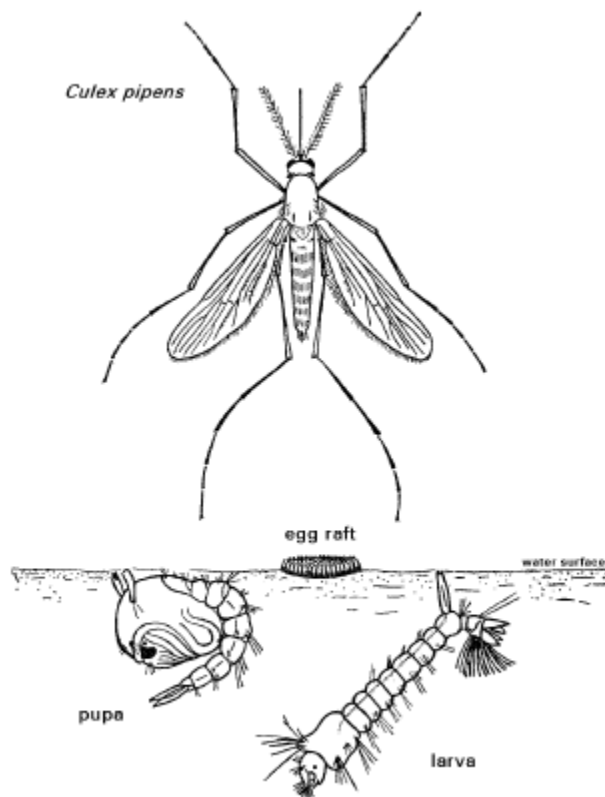
Most people infected with WNV show no symptoms or signs of the disease. Symptoms of WNV infection in people include fever, headache, muscle weakness, and in some cases, skin rash and swollen lymph glands. Most infections are mild and last a few days. More severe symptoms can last several weeks and include high fever, neck stiffness, disorientation, nausea, tremors and convulsions. In rare cases infection leads to the inflammation of the brain (encephalitis) and death. The incubation period is 3-14 days after being bitten by an infected mosquito. People of age fifty and older are considered the highest risk group although younger people (in their thirties and forties and as young as three years old) have been infected. If you develop the severe symptoms contact a physician immediately. However, it is important to keep in mind that most mosquito bites will NOT result in WNV infection. And less than 1% of persons infected with West Nile virus develop severe illness.

Other mammals reported to be infected with WNV (but show no signs of infection) include black bears, white-tailed deer, cats, dogs, bats, chipmunks, skunks, squirrels, and domestic rabbits. However, all these mammals are also believed to be "dead end hosts" and can not become a reservoir of infection. There is no evidence for animal-to-person infection, or for animal-to-animal infection (with the exception of predatory birds feeding on infected birds). There

is no reason to destroy a domestic animal just because it is infected with WNV. It is likely that it will recover from the infection.

## **MOSQUITO BIOLOGY AND CONTROL**

**Biology:** There are four developmental stages of mosquitoes: egg-larva-pupa-adult. *Culex* mosquitoes have been shown to be the most important vectors of WNV. Adult females lay eggs in a raft of 100-300 eggs on the surface of standing water (every third night during the lifespan) usually at night. Eggs hatch into larvae which feed on aquatic microorganisms. They have to frequently come to the surface of water to breathe. The pupa is a non-feeding stage from which an adult emerges. The length of time for the development from egg to adult varies depending on the water temperature and mosquito species. It usually takes only from 7 to 10 days but sometimes up to several weeks.



### *Culex pipiens* life cycle.

The adult life span is usually several weeks and depends on the environmental conditions (e.g. temperature, sources of food). Adults have two wings and can fly, although *Culex* species usually do not travel long distances. Both sexes feed on nectar to gain energy, however, only female mosquitoes bite and ingest blood (necessary for the formation of eggs). Females are attracted to the host by sensing carbon dioxide (CO<sub>2</sub>) from breath and skin as well as host odor, temperature, color, and movement.

*Culex pipiens* and *Culex restuans* prefer to bite/feed on birds (ornithophilic) but if their breeding sites are close to human dwellings they may bite people and domestic animals. *Culex pipiens* breeds in standing water, especially in water polluted with organic matter. It is most active at dusk and dawn

*Culex salinarius* feeds indiscriminately on both birds and mammals and readily bites people. It is found in fresh and saltwater marshes, lakes, ponds and many types of man-made containers around human residences. It is active from sunset to sunrise.

*Culex tarsalis* is one of the most abundant mosquitoes in Kansas. It breeds primarily in rural areas in temporary to semi-permanent depressions in pastures, ditches, and springs. It is most active at dusk and feeds on domestic animals (most frequently on cattle and chickens) and people.

The primary mosquito season in Kansas is May through mid-September, although in some years several species can be seen as early as February and as late as November. *Culex* species overwinter (survive the winter) as adults.

## **Control:**

### I. Reduction of mosquito breeding sites in communities – backyards and around houses

The most effective method of controlling mosquito populations is targeting the **larval** stage and the sites where it can develop. Once mosquitoes become flying adults, control is more difficult and expensive.

- eliminate artificial water holding containers (routinely - once a week - empty buckets, cans, bottles, used tires)
- fill or drain tree holes, stumps, and puddles
- irrigate gardens and lawns carefully to prevent water standing for more than a few days
- check for trapped water in plastic covers on boats, swimming pools etc..
- empty unused buckets, water troughs
- make sure that rain gutters are clean and do not hold water
- clean bird baths and water bowls for animals at least once a week
- stock your garden ponds with mosquito eating fish (e.g. minnows, goldfish)
- aerate ponds and swimming pools
- eliminate aquatic vegetation from around the water edges (e.g. garden pond) which allows predatory agents (fish and beneficial predatory insects) to reach the mosquito larvae.
- when feasible, the raising and lowering of the water level will allow for predatory fish to reach where the mosquito larvae are found
- *before considering a control by chemicals one must ascertain that mosquito larvae are present.* This is done easily by using a white dipper on a long pole; but if one is not available, a white plastic container (such as a cottage cheese container) should be adequate for scooping out a water sample. Wigglers (larvae) and tumblers (pupae) are easily recognized in this way. Always read and

follow the instruction on the product label. Products available:

- products based on the bacterium *Bacillus thuringiensis* var. *israelensis* (*B.t.i.*). This bacterium is selectively pathogenic to mosquito and blackfly larvae. Trade names: **Vectobac (Vectobac 12 AS, Vectobac G), Gnatrol, Mosquito Dunks.**
- products based on the bacterium *Bacillus sphaericus* - Trade name: **VectoLex**
- products based on the chemical Methoprene kill mosquito larvae by disrupting their development: Trade names: **Altosid XR–G and Strike.**

## II. Personal protection

- when outdoors apply insect repellent containing DEET (N,N-diethyl-meta-toluamide). The more DEET the repellent contains the *longer* (not better !!) it will protect you. However do not use products containing more than 30% DEET. Pay close attention to the product label especially regarding the use for children.
- wear long-sleeved clothes and long pants treated with repellents containing DEET or permethrin (mosquitoes may bite through thin clothing). Do not apply permethrin directly on your skin.
- if possible avoid being outdoor at dusk and dawn (periods when mosquitoes are most active).
- make sure that screens on doors and windows are tight and without holes
- to our knowledge there are no quantitative studies showing that mosquito traps based on release of CO<sub>2</sub> lower the mosquito population to the point where there is a noticeable decline in nuisance levels.
- place netting over carriers with infants when being outdoor

## III. Reduction of mosquito breeding sites in rural/farm areas

### a) *Animal waste lagoons*

The water of animal waste lagoons is usually heavily laden with organic matter which might affect larval development. However, in some situations mosquito and midge larvae can develop in great numbers in these places. Thus it is important to determine whether or not mosquito larvae are present before embarking in a control program.

Usually, the appropriate use of insecticides will bring an infestation under control within 1 to 3 days. Because mosquito breeding occurs in a zone about 10 feet wide from the shoreline outward, it is not necessary to treat the entire surface area of the lagoon. Calculate treatment needs based on a 10 foot wide band around the circumference of the lagoon. Products available:

1) **VectoLex CG, VectoLex WSP** are biological larvicides containing the bacteria *Bacillus sphaericus*.

2) **Vectobac** products (**Vectobac 12 AS, Vectobac G), Gnatrol, Mosquito Dunks** are biological larvicides based on the bacterium *Bacillus thuringiensis* subs. *israelensis*

3) **Altosid XR–G** and **Strike** are based on an insect growth regulator Methoprene that kills mosquito larvae by disrupting their development. This product comes in a variety of formulations, but pellets and briquets are the best suited for farm lagoons.

4) **Abate** products (**Abate 43EC, Abate 1, 2 or 5G, Clarke 5% Abate, 1%**

**Skeeter Abate**) are based on an organophosphate compound Temephos that is an effective mosquito larvicide. However, this product is not specific to mosquito larvae and will affect other insects and invertebrates in the water.

5) Specially formulated Mineral Oils (**Bonide Mosquito Larvicide** and **BVA Chrysalin**), naphthenic oil (**Mosquito Larvicide GB 1111**), distilled petroleum oil (**BVA Larvicide2**), and monomolecular surface films such as **Agnique MMF 5996** may be applied to lagoon surfaces to smother mosquito larvae and pupae.

#### b) *Used tires*

No matter how a tire is oriented, it always collects water and becomes an ideal breeding site for several mosquito species. *Culex pipiens* and *Cx. restuans* and *Aedes albopictus* (the Asian tiger mosquito, a mosquito highly suspected of being a WNV vector also), are species which readily colonize the aquatic habitat offered by tires. Whereas the outdoor storage of tires by businesses is regulated by KDHE solid waste management statutes, the storage and utilization of used tires in agricultural facilities are exempted from the regulation. In some states, tires used in agricultural facilities must be either cut in half or holes punched to prevent water accumulation and subsequent mosquito breeding. If the control of mosquito breeding in tires has to be implemented using chemicals, there are various larvicides available:

1. If the number of used tires is not excessive, the **common rock salt** can be as effective as any of the commercial pesticides. A handful of this chemical per tire should last for an entire season.
2. **Altosid XR-G** (Methoprene), an insect growth regulator, is highly effective and of very low mammalian toxicity.
3. **Abate** (Temephos), an organophosphate, is highly effective as pellets in these habitats (at a rate as low as one pellet/tire).
4. **Vectobac, Gnatrol, Mosquito dunks** (*Bacillus thuringiensis* var. *israelensis*) and **Vectolex** (*Bacillus sphaericus*) are based on toxins from these bacteria. These are chemicals highly specific against insects and have very low mammalian toxicity. These are generally sold as pellets, granules or 'donuts'.

The application of the various formulations of these chemicals must consider the difficulty in getting the material to every tire, whether stacked or laying singly. Improper and incomplete coverage will result in ineffective mosquito control.

#### c) *Livestock drinking tanks*

At times, watering tanks can become habitats for mosquito larvae. If the water surface in the tank can be aggressively agitated, this will negatively affect the development of the larvae (but will not give complete control) as they will not be able to suspend themselves from the water surface for breathing. If it has been determined that mosquito larvae are breeding in a water tank, following larvicides are available: **Vectobac, Mosquito dunks** (*Bacillus thuringiensis* var. *israelensis*). Briquets and donuts have to be enclosed in metal screens so horses or other domestic animals do not consume them. The products are safe for animals but do not do the job if they are eaten.



Animal drinking tank with fish.

d) *Road ditches and depressions in pastures*

Before making any decision to treat make sure that these sites are holding water for more than 4 days and, if so, that they do contain mosquito larvae (using the methods described above). If you find out that there are mosquito larvae in these sites: 1. If possible, drain or fill up these sites with soil

2. **Vectobac, Mosquito dunks** (B.t.i. products) are suitable for control in this environment.

ALWAYS BE SURE TO FOLLOW THE PRODUCT LABEL INSTRUCTIONS !

**West Nile virus facts to remember:**

- most mosquito bites do not lead to WNV infection
- less than 1% of people infected with WNV develop severe illness
- there is no evidence that insects other than mosquitoes play a role in the transmission of WNV in the United States. (Ticks have been found infected in Asia and Africa, however, there is no evidence that ticks play a role in WNV transmission in the United States).
- WNV can not be transmitted from person-to-person, or animal-to- person (e.g. person can not get WNV from handling the dead bird, infected horse, cat, etc..)
- there is no documented evidence that pregnancy is at risk due to infection with WNV
- there is no evidence that children are more susceptible to WNV infection than adults
- it is assumed that a person infected with WNV will develop lifelong immunity



- follow the guidelines for personal protection and minimize mosquito breeding sites on your property

Recommended web-sites on mosquitoes and/or WNV:

<http://www.cdc.gov/>

<http://www.epa.gov/pesticides/citizens/larvicides4mosquitos.htm>

<http://www.kdhe.state.ks.us/health-info/#M>

<http://www.oznet.ksu.edu/westnilevirus/>

[http://cindi.usgs.gov/hazard/event/west\\_nile/west\\_nile.html](http://cindi.usgs.gov/hazard/event/west_nile/west_nile.html)

<http://www.mosquito.com>

<http://whyfiles.org/016skeeter/index.html>

<http://www.cfe.cornell.edu/erap/WNV/default.cfm#mosquitohygiene>

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