

# Mosquitoes vs Head Lice: A Control Comparison

by John Beidler

The Florida Department of Agriculture and Consumer Services (FDACS) compiles and posts pesticide application data for every mosquito control program certified by the State each fiscal year (FY); see <http://www.freshfromflorida.com/Divisions-Offices/Agricultural-Environmental-Services/Business-Services/Mosquito-Control/Reports>. According to FDACS, 18 million acres were treated for mosquitoes using insecticides applied by ground ULV in FY 2009-10 (FDACS 2010). Of that total, 16 million acres were treated with various formulations of the active ingredient (ai) permethrin; see Figure 1. These formulations also contain the synergist piperonyl butoxide (PBO). Dosages ranged from a high of 0.0065 pounds of ai per acre (lb/ac) to a low of 0.0009 lb/ac, with a label application rate range of 0.00175 to 0.007 lb/ac. The average application rate for all ground ULV use of permethrin was 0.0034 lb/ac, while no one in Florida actually used the maximum rate of 0.007 lb/ac.

Keep this number in mind.

## PUBLIC REACTION

Do we really know how many people may have been incidentally exposed to permethrin when those 16,000,000 acres were treated? While most

individuals may never have been exposed to ground ULV applications, others may have been exposed only once, some multiple times. Whatever that number might be, I think it's a credit to our industry as a whole – chemists, manufacturers, distributors, label approvers such as FDACS and the US Environmental Protection Agency (EPA) and mosquito control agencies – that this is accomplished year after year with so few serious complaints, or even inquiries as to what we are doing – *just kill the mosquitoes*; see Figure 2. But as might be expected among those who may have been incidentally exposed, some will ask questions: *Is the pesticide you're using safe? Will it hurt my kids? Will it hurt my dogs?*

Your answers can be varied. You can reply that *"We follow the pesticide label and regard it for what it is – THE LAW."* You can point to the aforementioned record of few complaints. What you can't say, however, is that a pesticide is "safe." In fact, nowhere on a mosquito control product label does the word "safe" appear. EPA registers all pesticides used in the US and reviews and approves their labels – and has generally taken the position that the word "safe" on pesticide labeling is considered to be false or misleading. Why? Because any product intended to kill or repel something cannot be

characterized as 100% safe. Instead, the agency has always stressed that by following the label directions for use, pesticides can be used *safely*, protecting both people and the environment, while effectively repelling or killing the intended pest.

## HELPFUL COMPARISONS

When discussing potentially controversial (and complex) subjects like chemical usage or dosage with the public, it is often helpful to have comparisons, so others can more easily comprehend. To this end, let me introduce you to the head louse, *Pediculus humanus capitis*; see Figure 3. I am sure some of you are, unfortunately, well acquainted with this insect, a small parasite frequently found on the head of unsuspecting schoolchildren, much to the dismay of their parents. A while back I saw a product for head lice control while wandering the aisles in Publix, a large grocery chain based in Florida (we retirees do that sort of thing). The first thing that I noticed on the package was a big label stating: "SAFE." Then I saw that the ai was our friend, permethrin.

There are at least 6 insecticide active ingredients commonly used for head lice control in the US: malathion, pyrethrins (with PBO),

FORMULATION (permethrin + PBO)	TOTAL ACRES (IN MILLIONS)	ACREAGE (% TOTAL)	AVERAGE DOSE (LBS/ACRE)	NUMBER OF MOSQUITO CONTROL PROGRAMS
30 + 30	7.4 M	47%	0.0039	19
4 + 4	5.0 M	32%	0.0022	17
3 + 15	1.3 M	8%	0.0013	4
31 + 66	1.3 M	8%	0.0059	5
20 + 20	0.8 M	5%	0.0046	13

Figure 1: Table of permethrin formulations applied by Florida mosquito control programs in FY 2009-10.

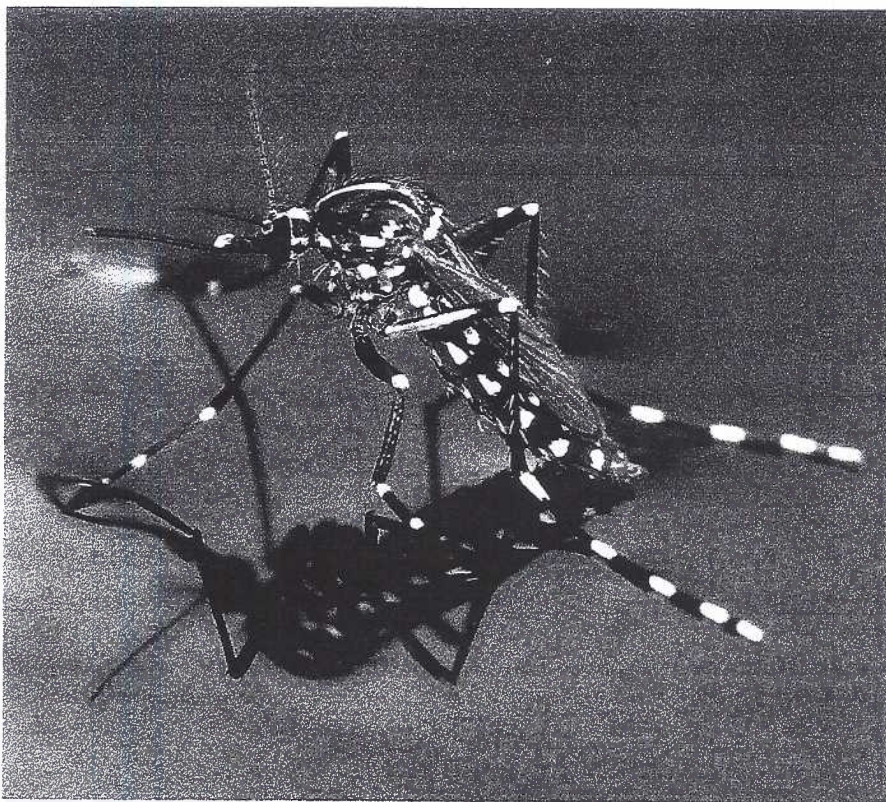


Figure 2: The Asian tiger mosquito, *Aedes albopictus*.  
Photo by Sean McCann

spinosad, ivermectin, benzyl alcohol and permethrin; see Figure 4. Only products containing pyrethrins and permethrin can be purchased over-the-counter (OTC), the others available by prescription only. According to the US Centers for Disease Control and Prevention (CDC) the 6 insecticides can be arranged by the age limitation, "for use on children" (CDC 2013). How those age limitations are determined is another story, but what is important for this article is that permethrin, "our" major player, is the best of the lot, as it can be used on a two-month-old infant.

So back to our permethrin louse product, which goes by the brand name of NIX®. Inside each box are two 2-ounce bottles of a 1% solution of permethrin. Each bottle contains 560 milligrams (mg) of permethrin, sufficient for a single treatment. It is applied to the hair and scalp, worked in for 10 minutes and then rinsed out. The treatment kills the adult stage, but not the eggs,

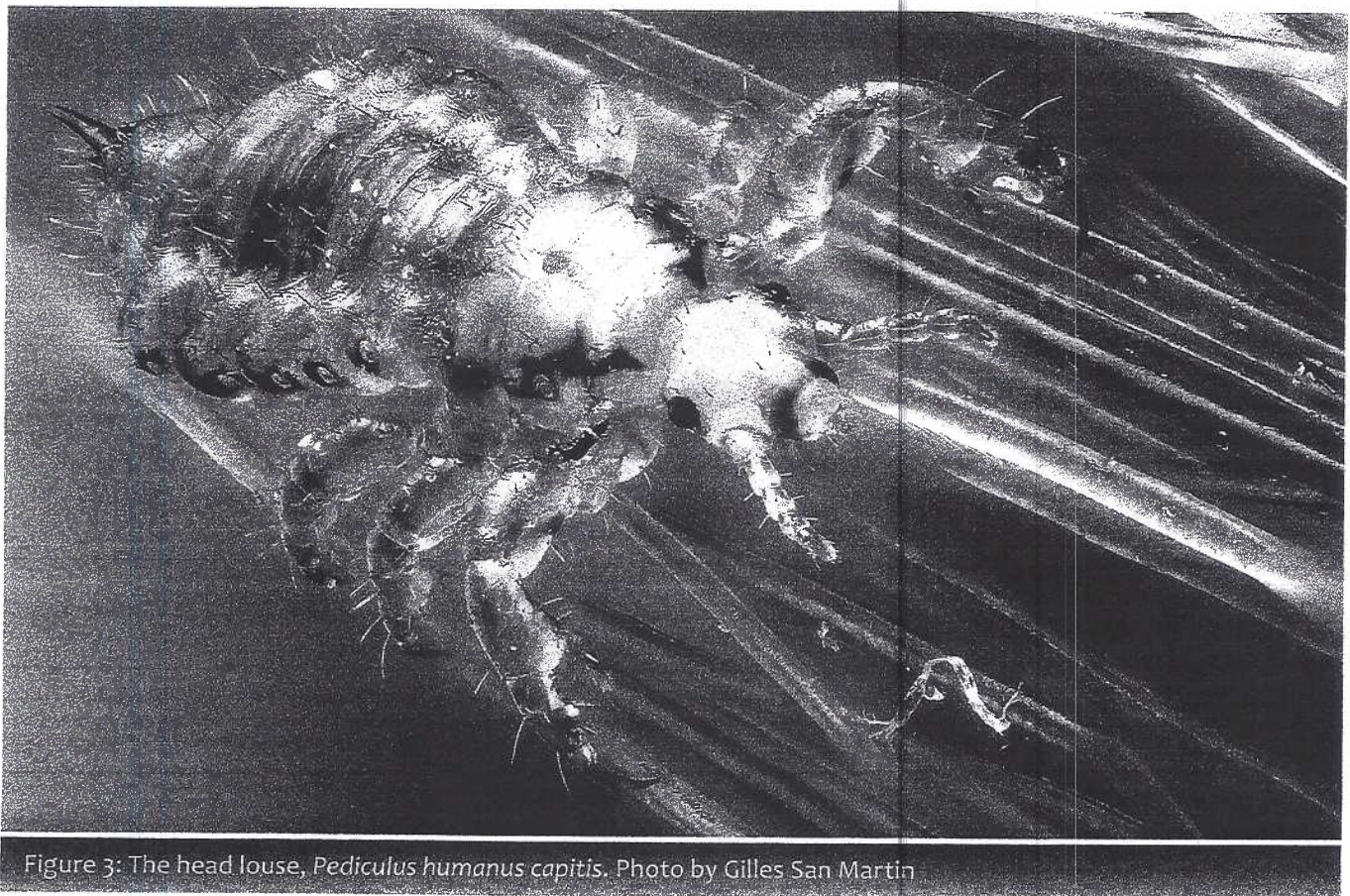


Figure 3: The head louse, *Pediculus humanus capitis*. Photo by Gilles San Martin

PEDICULICIDE ACTIVE INGREDIENT	MINIMUM CHILD'S AGE	PRESCRIPTION NEEDED?
MALATHION	6 YEARS	YES
SPINOSAD	4 YEARS	YES
PYRETHRINS + PBO	2 YEARS	OTC
BENZYL ALCOHOL	6 MONTHS	YES
IVERMECTIN	6 MONTHS	YES
PERMETHRIN	2 MONTHS	OTC

Figure 4: Six commonly used products for head lice control in the United States.

called nits, which are glued to the base of hair shafts; a fine-toothed comb is provided for their removal. Any nits missed by the comb will hatch in 7 to 10 days, so treat again, even the baby. No mention is made of gloves for use by the applicator, but the product must be kept out of body openings and can't be used around the eyes, eyebrows and eyelashes.

#### DOSAGE: MOSQUITOES VS LICE

Dosage for mosquito adulticiding is generally stated in *pounds* of active ingredient per acre – even though we are actually treating the space over the acre, not the ground itself. As noted, the ground ULV label rates for the previously mentioned permethrin formulations is 0.00175 to 0.00700 lb/ac. It is active ingredient per area which we will compare. Remember, the average permethrin application rate used in Florida is 0.0034 lb/ac.

So what is the area covered with a head louse treatment? Let's assume that the head is a 6-inch sphere, half covered with hair (and lice). The surface area of a 6-inch sphere ( $4\pi r^2 = 4 \times 3.14 \times 3^2$ ) is 113 square inches (sq in), so we'll consider the hair half to be about 56 sq in. The treatment dose was 560 mg per head, so that makes the dose per square inch 10 mg (560 mg/56 sq in = 10 mg/sq in), which is an easy figure to work with. Ten mg is equal to 10 thousandths of a gram, which doesn't sound like much. However, let's see: since 1 square foot (sq ft) equals 144 sq

in, 10 mg per sq in x 144 sq in equals 1.44 gram (g) per sq ft. Do you think that is still not much? But wait, there's more: we now need a per acre figure for our comparison.

Since there are 43,560 sq ft per acre, we must multiply our 1.44 g per sq ft times that amount to get g per ac. This comes to be a whopping 62,726 g per ac. The last step is to convert grams to pounds, which Americans understand, by dividing by 453.592 (453.592 g = 1 lb). The answer is an equivalent dose, area to area, of slightly over 138 lb/ac. That application rate is over 40,000 times greater than our average mosquito dose of 0.0034 lb/ac – or almost 20,000 times the maximum ground ULV rate of 0.007 lb/ac!

If we converted 138 lbs ai to gallons of product, we would be pouring 55 gallons of the 30-30 formulation (or 489 gallons of a 4-4 formulation) on an acre – about the size of a football field – and either would be considered a major chemical spill! This can be expressed in a number of other ways such as sq ft treated per dose, 560 mg per half head for lice or 16,000 sq ft for mosquito control. The amount of permethrin used in 3 head lice treatments would cover over an acre for an adult mosquito ULV application.

So what do these projections prove? They demonstrate how on the one hand our comparatively low dosage of 0.0034 lbs per acre is considered unsafe by critics, yet how under the different

circumstance of louse control, it is not only effective, but is considered "safe" by Federal authorities when using a much higher dose. Use this trivia as you would like. It was an enjoyable mental exercise.

I can hear it now: "John doesn't have enough to do!"

#### REFERENCES CITED

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