Using Field Cage Trials to Assess ULV Droplet Penetration for Controlling *Culicoides furens* in Brunswick, GA



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THE AMERICAN MOSQUITO CONTROL ASSOCIATION

Overview

- Biting midges (Diptera: Ceratopogonidae: *Culicoides*) commonly called “no-see-ums” ”punkies” “sand flies”
- 78 Genera, over 4,000 species world-wide, 1,000 species belong to *Culicoides*, feed on humans and animals
- Known for their painful persistent bites, pool feeders, only females feed on blood
- Thrive in aquatic and semiaquatic habitats, organically rich substances



- <u>Medical / Veterinary Importance:</u>
  - Can transmit over 20 known viruses
    - Bluetongue virus (BTV)
    - Cellulitis (from secondary infections)
    - African horsesickness (AHS)
    - Epizootic Hemorrhagic Disease (EHDV)
    - Number of protozoans & filarial nematodes
    - Oropouche virus (OROV) *Culicoides paraensis* Goeldi



Photo courtesy: Dunpharlain

Overview

- *Culicoides* control
  - Widespread use of insecticides, yet little is known in assessing their susceptibility

Study Objectives:

1) Successfully collect, sort and transfer field-collected *Culicoides* for field bioassay trials

2) Determine how different mesh size affects the size of ULV droplets and penetration

3) Determine the effectiveness of ULV pyrethroids on caged *Culicoides* at 31, 61 and 91 m

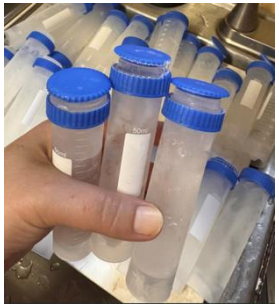
Collection Methodology

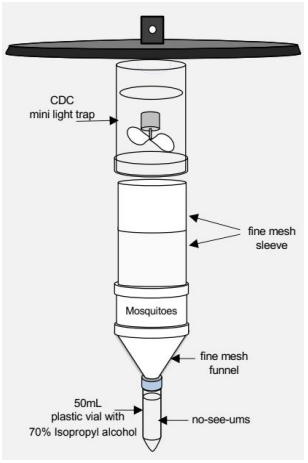
- <u>Study: May – Oct 2025 Brunswick, GA</u>
- 6 trapping locations
- CDC light traps baited with dry ice, deployed from 1700 - 0800
- Modified collection containers

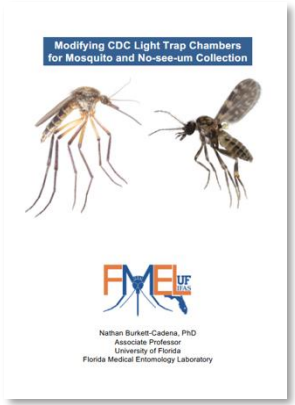










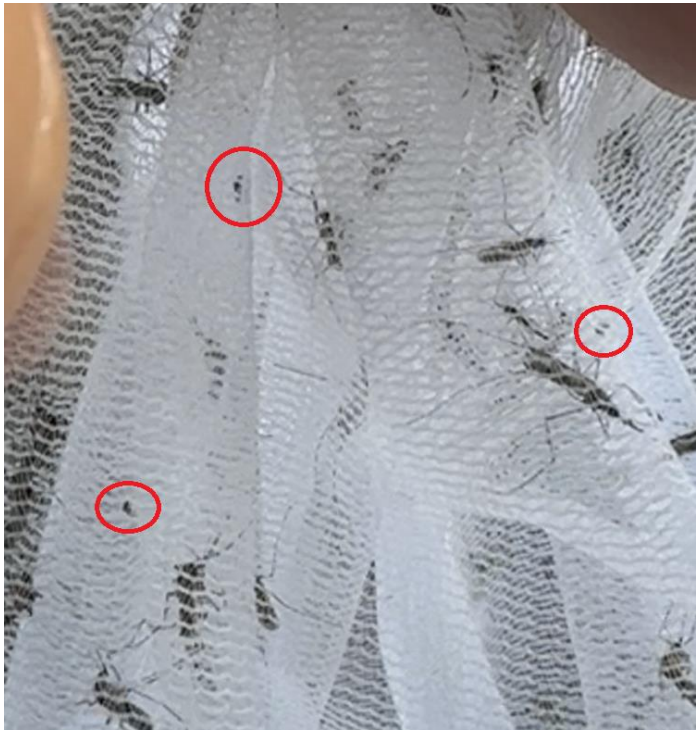


Nathan Burkett-Cadena
Florida Medical Entomology Lab

It’s a mixed bag…

and not easy to sort the Biting-Midges from Mosquitoes within these nets

Especially if your goal is to keep them alive for a cage trial



Collection Methodology

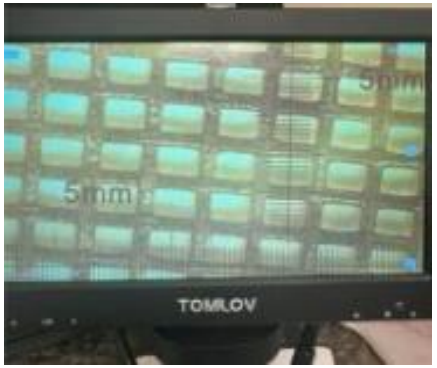






“Typical” Window Screen is not fine enough to contain them…





1.0mm = 1,000um



Collection Methodology

- *Culicoides* were aspirated from 50 ml conical vials directly into bioassay cages, sealed with a 10% sucrose cotton plug
- 10 - 25 adults per cage
- Cages kept in a cooler with moist paper towels until application
- Observed large numbers would die by between netting and edge of cage

- Over 3,000 specimens collected, majority collected during May and Oct, subsample identified as *C. sonorensis* and *C.furens* using photographic key

(Blosser et al. 2024)



Screen Size and Droplet Penetration

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The biological effect of cage design corrected for reductions in spray penetration

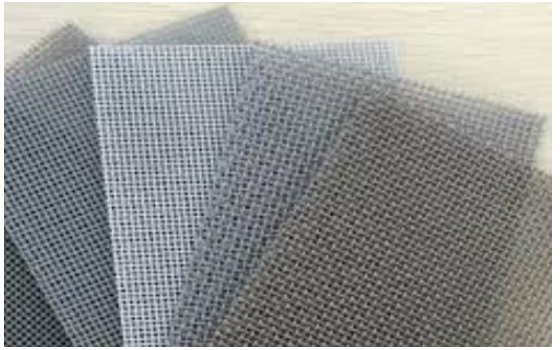
*Bradley Keith Fritz[1], Wesley Clint Hoffmann[1], Jane Annalise Sara Bonds[2], Keith Haas[3], Zbigniew Czaczyk[4]**

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Penetration inefficiencies of applied sprays into bio- assay cages are due to screen porosity (Breeland 1970; Boobar et al. 1988; Barber et al. 2006) and cage type and geometry (Breeland 1970; Boobar et al. 1988; Bunner et al. 1989; Hoffmann et al. 2008). All of the above affect spray and air flow penetration into the cage. The screening material itself will tend to collect the spray material and there is a relatively high collection efficiency (Fox et al. 2004; Fritz and Hoffmann 2008a).

30-70% reduction in spray cloud inside vs in front of cages.

The mesh type acted as a regulator. Although the conversion factor was effective, the differences between cages was not always significant due to within-group variation



How fine do screens get?

This depends on the thickness of the wire or strand used to make the mesh. Most ISM flow control components do not contain filter screens any finer than 500 mesh. The primary reason for this is that as the mesh number rises, the space between the wires or strands becomes smaller. At some point the mesh number becomes so high that the percentage of open area is too low to be useful. This point is usually somewhere between 450 and 700 mesh depending on the diameter of the wire or filament used.

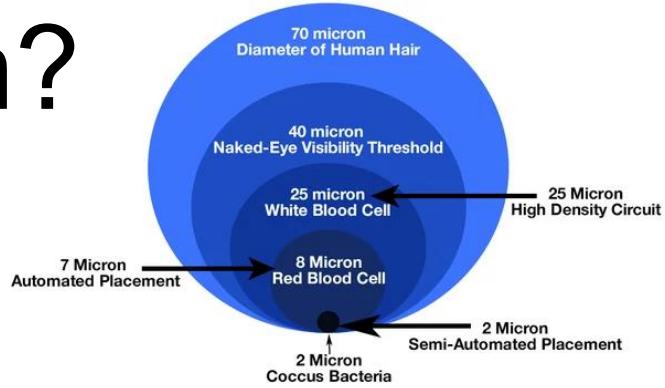
Note: Beyond 325 to 400 mesh, particle size is normally described only in microns.

US Mesh*	Microns	Inches	Millimeters
35	500	0.0197	0.5
40	400	0.0165	0.4
45	354	0.0138	0.354
50	297	0.0117	0.297
60	250	0.0098	0.25
70	210	0.0083	0.21
80	177	0.007	0.177
100	149	0.0059	0.149
120	125	0.0049	0.125
140	105	0.0041	0.105
170	88	0.0035	0.088
200	74	0.0029	0.074
230	63	0.0025	0.063
270	53	0.0021	0.053
325	44	0.0017	0.044
400	37	0.0015	0.037
450	32	0.0013	0.032
500	25	0.0010	0.025
635	20	0.0008	0.020

**Values are based on the American National Standard for Industrial Wire Cloth (American Standard ASTM - E 11).*

How small is a micron?

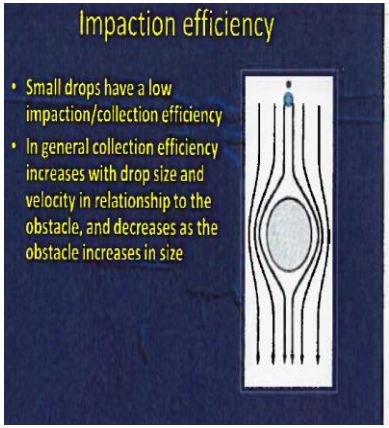
1 um = .00003937 inches



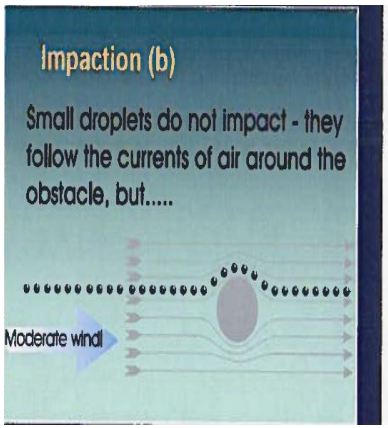
The volume of one BB 

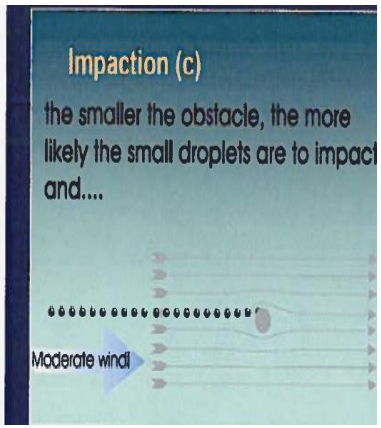
9,761,000	20 micron droplets
15,097,991	17 micron droplets
74,088,000	10 micron droplets

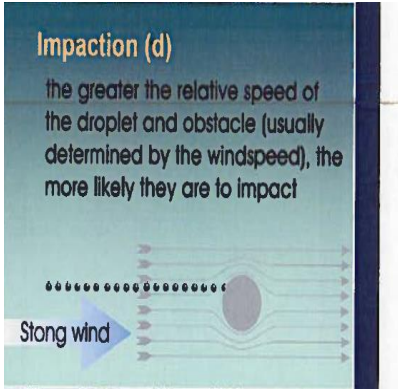
How Does ULV Droplet Behave?

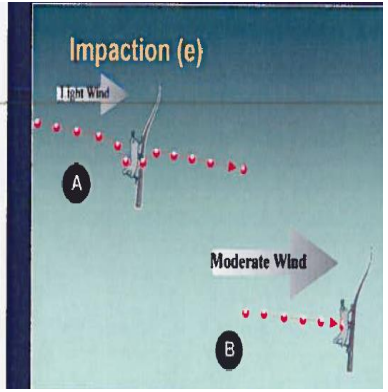


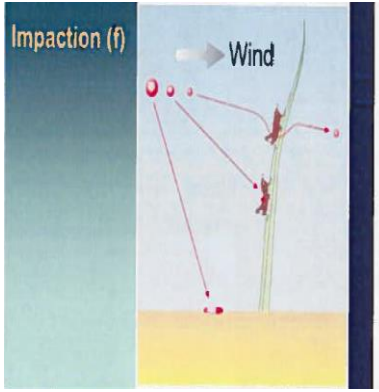


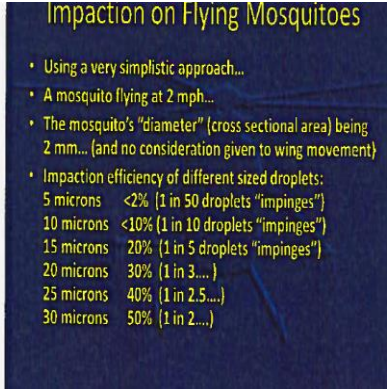






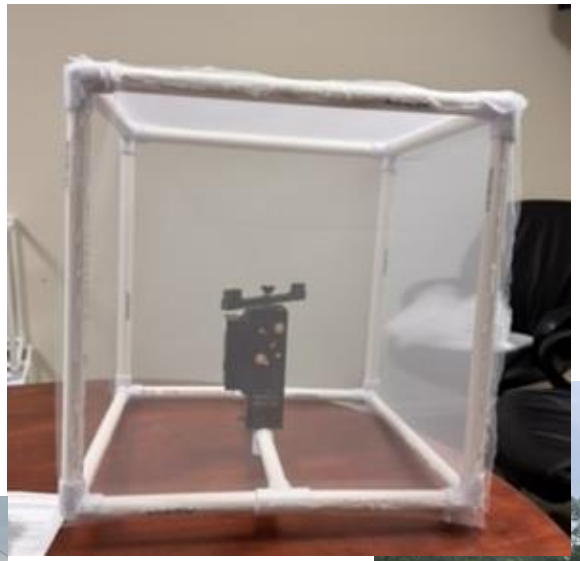






Screen Bioassay Field Trials

How do droplets move through cages in a semi-field vs lab scenario?







Screen Bioassay Field Trials

- 3 Screen cage types: Tulle, No-see-um, Window screen
- Spinners inside cages and placed at 31, 61, 91 m + Control
- 4 Replications (12 cages)
- Slides were analyzed using DropVision® basic 4.0



Tulle
1.3mm = 1,300um





NoSeeUm Netting
<0.6mm = 600um



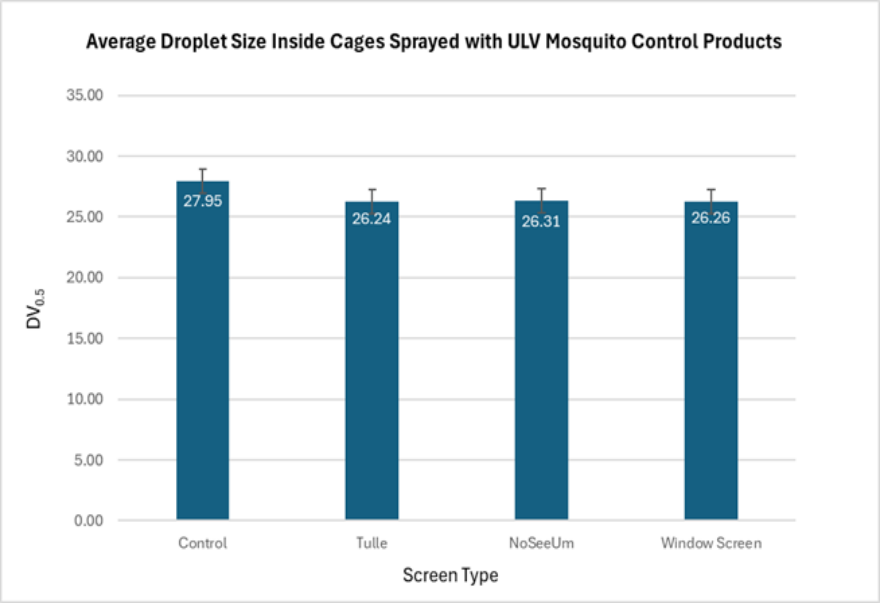


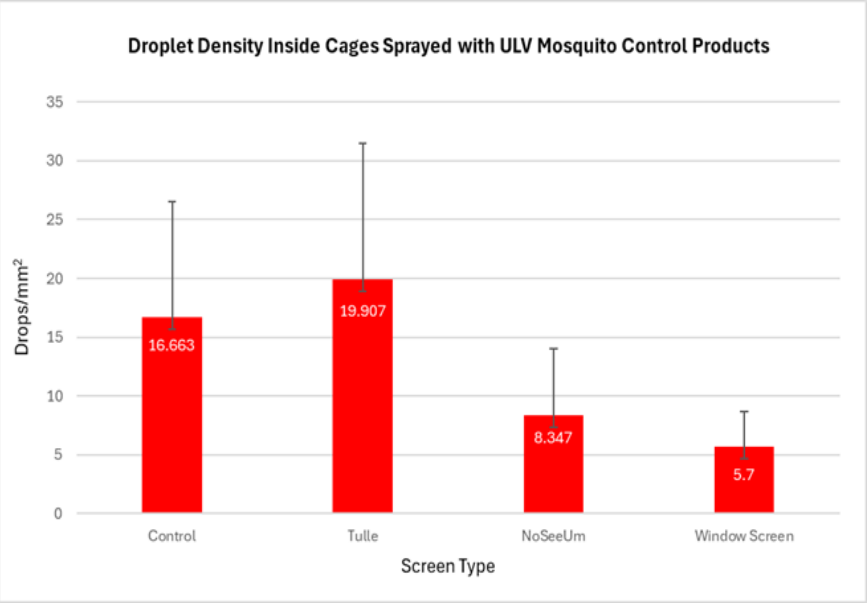
Window Screen
1.0mm = 1,000um



Results

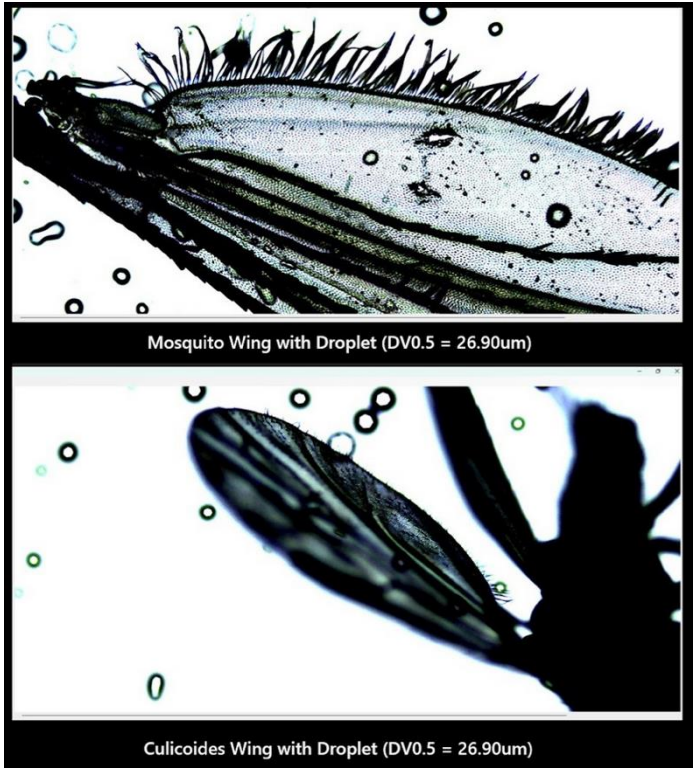
Droplet Size and Droplet Density Inside Cages

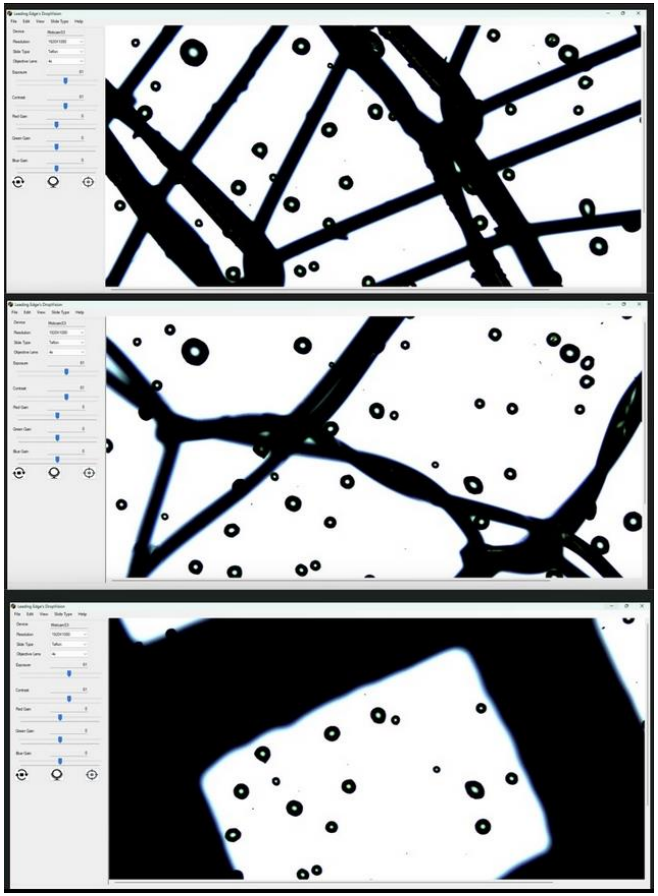




Perm3030 mixed 1:7 and sprayed at
mid-label (0.0035lbsAI/Acre)
8.7 oz/min at 10mph

Average Wind = 3.4mph (Range of 2.1 to 6.2)
Relative Humidity = 71% (Range of 65-80)
Average Temp = 85F (Range of 83-86)





NoSeeUm Net

Tulle

Mosquito Screen

Evaluating the Efficacy of Pyrethroids on Wild Caught *Culicoides*

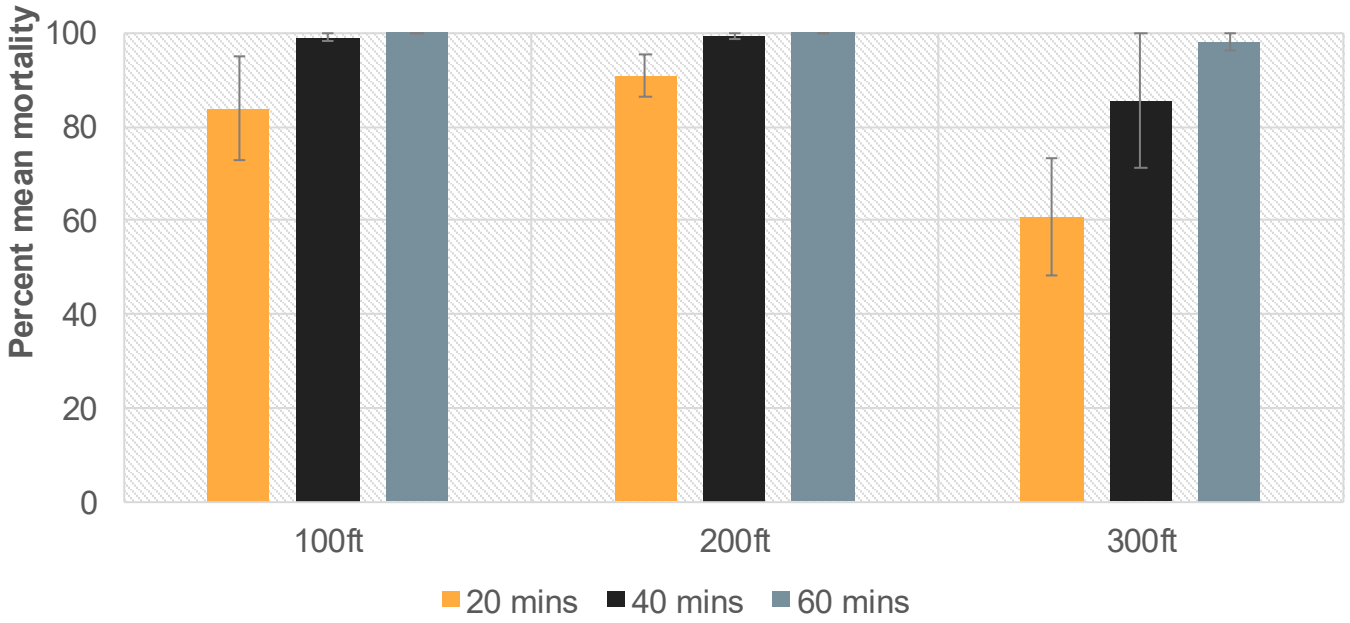
- Anvil sprayed with Grizzly ULV truck mounted sprayer @ 10 mph
- Spinners top of poles with 2 cages per pole
- Cages contained 10 – 25 *Culicoides*
- Poles placed at 31, 61, 91 m + Control
- 4 Replications
- Mortality recorded at 0, 20, 40, 60 min
- Slides were analyzed using DropVision® basic 4.0





Results

Mean Mortality of field collected *Culicoides* post exposure to ULV application of Anvil



Summary

- Given the high mortality rate, future work on developing methods for transferring and keeping *Culicoides* alive for longer periods is warranted
- Our results and recently published studies have demonstrated no-see-um netting is effective to evaluate field cage trials (Cooper et al. 2025a)
- Our results follow similar studies confirming effectiveness of ULV permethrin on *Culicoides* mortality (Copper et al. 2025b)
- Future studies should focus on timing of ULV applications and *Culicoides* activity as different species are active at different times (Carpenter et al. 2008)
- Other factors (wind, canopy, droplet size, equipment settings) may be more influential than spray distance, as the effect of stratification / canopy height may influence *Culicoides* population fluctuations (Copper et al. 2026)

Questions?

Don’t hesitate to reach out



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