“It’ll NEVER work!

The use of aerial applications in the control of peridomestic vectors

Peter H. Connelly and Charles A. Silcox, Ph.D.
AMVAC Environmental Products   Mar 2017
It’ll NEVER work!

• "You’re going to do WHAT with our cloaking technology?"
• Prior to 1961 – “You'll never control mosquitoes by air"
• Early 70's cold aerosol fogging... "It will never work"
• “You will never get water to behave like oil in ULV applications”
• "You will never hit that spray block with a 7000 foot offset”
• “Naled will never be used in California for mosquito control”
• "You cannot control Aedes aegypti with aerial applications“

Our thoughts are constrained by what we KNOW—
or what we think we know!
It’ll NEVER work!

• “We will never make a 32 bit operating system.”
  — Bill Gates

• There is no reason anyone would want a computer in their home.”
  — Ken Olson, president, chairman and founder of Digital Equipment Corp. (DEC), maker of big business mainframe computers, arguing against the PC in 1977

• “‘There is not the slightest indication that nuclear energy will ever be obtainable. It would mean that the atom would have to be shattered at will.”
  — Albert Einstein, 1932

• “The horse is here to stay but the automobile is only a novelty – a fad.”
  — The president of the Michigan Savings Bank advising Henry Ford’s lawyer, Horace Rackham, not to invest in the Ford Motor Co., 1903

• “This ‘telephone’ has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us.”
  — A memo at Western Union, 1878 (or 1876).
State of the ART
Current State of the Art

Wind
Why is this important?

- In 1961 dengue was found in 7 countries only. Now over 100
- WHO indicates 40 to 50% of the global population lives in dengue endemic areas
- The malaria toll equivalent is a number you will not believe
- Thousands of people die and suffer each day while we have thresholds for control that seem trivial in comparison
- Dr. Nielson, Meek, Chapman, Bidlingmeyer, Meisch, Mulrennan, Perich, Tidwell, Provost, Livingston, Pant, Self, Etc did it before we got here, and we owe it to all those that will follow us.
- We now have locally acquired CHIKV, Dengue and ZIKA in the U.S.

- It's the right thing to do!!
Global *Aedes aegypti* Project (GAaP)
# Summary of all scores

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IMPROVING THE ODDS

- **Surveillance** – Trapping and landing rates to determine best timing for adult control
- Use a **smaller VMD** – at or below 30 um - Micronair, High Pressure or better
- Use an aircraft capable of **flying low enough and with significant vortices**.
- **Use the latest technology** including nozzle delivery systems, offset determination, flux modeling, real time weather /flight guidance
- **Timing**- Determine the periodicity where deployed and intervene EARLY !!

**Product selection**-
  - **Pre-determine susceptibility** to all products through your staff or independent sources.
  - Products with heavier specific gravity than all other Ai’s used (higher degree of predictability with smaller droplets.)
  - Rapid degradation in the environment
  - Make **multiple applications** if necessary timed carefully and ONLY in a fully integrated IPM program including source reduction, larval control and community awareness and action in REDUCING containers.
GAaP

Lit review - Prior attempts
- AFPMB
- JAMCA
- others

Consults - Prior attempts
- Bordes, Carroll, Clark, Gubler

Theory
- Technology gap
- What if?

Consortium
- Mark Latham
- USDA
- DOD
- CDC

Plan of work
- Field trial sites/cooperators

Proof of Concept
- 2013 - Camp Blanding
- 2014 - Camp Blanding
- 2015 - New Orleans
- 2016 - PR
- 2016 - Miami Dade
Starting supposition

• If there is no known resistance developed in the target insect to a product
• Getting the product to the target insect is all that matters

• If in aerial ULV applications you can correct for >>>
  • larger droplets that often do not reach the intended target
    • Settling prior to reaching the target
    • Waste of significant amounts of product

  –Use a product with the efficacy- no known resistance- and the specific gravity that will allow the product to reach the target
  –Incorporate this in an IPM program including community wide source reduction

• Solution…change the paradigm ! Change the results !
Global *Aedes aegypti* Project (GAaP)

Field Trials Conducted To Date

- October 2013 – Camp Blanding, FL
- August 2014 – Camp Blanding, FL
- July 2015 – New Orleans, LA
Global Aedes aegypti Project (GAaP)
Camp Blanding Testing
Starke, FL
October 2013

Blanding I
GAaP Trial – Starke, FL
Camp Blanding Trial – October 2013
MOUT Complex

“Open” Building

“Closed” Building
GAaP Trial – Starke, FL
Camp Blanding Trial – October 2013
Mosquito Bioassay Methodology

- Bioassay Cage
- Bioassay Cage
  - Outdoors on Pole
    (And Inside Box)
- Bioassay Cage
  - Indoors on Floor
    (And Inside Box)
- Spinner with 2 Glass Rods
- Outdoor Test Site
GAAP Trial – Starke, FL
Camp Blanding I Trial – October 2013

USAF C-130

IMG_0483.MOV
12 hour Aedes aegypti Mortality at MOUT Site on 29 October 2013
12 hour Aedes aegypti Mortality at MOUT Site on 30 October 2013

Building Type: Closed
Location: Inside
Inside Box (Y/N): Yes
N=4

Building Type: Closed
Location: Inside
Inside Box (Y/N): No
N=4

Building Type: Closed
Location: Outside
Inside Box (Y/N): Yes
N=3

Building Type: Closed
Location: Outside
Inside Box (Y/N): No
N=3

Building Type: Open
Location: Inside
Inside Box (Y/N): Yes
N=6

Building Type: Open
Location: Inside
Inside Box (Y/N): No
N=6

Building Type: Open
Location: Outside
Inside Box (Y/N): Yes
N=5

Building Type: Open
Location: Outside
Inside Box (Y/N): No
N=5

Application Date: 29 October 2013
Application Method: C-130 – MASS
Product/Application Rate: Dibrom EC / 0.84 fl.oz. per Acre
Altitude: 150 feet (AGL)
Speed: 200 knots (230.2 MPH)
Nozzle: SS8001 (24 nozzles)

Application Date: 30 October 2013
Application Method: C-130 – MASS
Product/Application Rate: Dibrom EC / 1 fl.oz. per Acre
Altitude: 150 feet (AGL)
Speed: 200 knots (230.2 MPH)
Nozzle: SS8003 (8 nozzles)
Global *Aedes aegypti* Project (GAaP)
Camp Blanding Testing
Starke, FL
August 2014

Blanding II
GAaP Trial – Starke, FL
Camp Blanding Trial – August 2014
Aircraft Information

Hughes 500D
Aircraft Information

- Aircraft: Hughes 500D
- Identification: N862MC
- Insecticide Delivery System:
  - High Pressure
- Spray Boom:
  - Custom 316 Stainless
  - Nozzles
    - 26 August: Bette PJ20 (2 Nozzles per boom; 4 Nozzles Total)
    - 27 August: Bette PJ10 (2 Nozzles per boom; 4 Nozzles Total)
- Pressure: 1,500 psi
- Flow Rate: 94 fl.oz. per minute (26 August)
  - 46 fl.oz. per minute (27 August)
- Differential GPS: Wingman®
- Information Management: AIMMS-20
GAaP Trial – Camp Blanding, FL
MOUT Complex – 26 & 27 August 2014

12 hour Aedes aegypti Mortality at MOUT Site on 26 August 2014 (n=3)
12 hour Aedes aegypti Mortality at MOUT Site on 27 August 2014 (n=3)

Percent Mortality (12 h)

Building Type:  
Closed  
Open
Location:  
Inside  
Outside
Inside Box (Y/N):  
Yes  
No

Application Date:  
26 August 2014  
27 August 2014
Application Method:  
Rotary – Hughes 500  
Rotary – Hughes 500
Product/Application Rate:  
Dibrom EC / 1 fl.oz. per Acre  
Dibrom EC / 1 fl.oz. per Acre
Altitude:  
150 feet (AGL)  
100 feet (AGL)
Speed:  
105 MPH  
50 MPH
Nozzle:  
HP  
HP Plus

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Global Aedes aegypti Project (GAaP)
Operational Testing
New Orleans, LA
July 2015

Nola I
Cooperating Organizations/Personnel

- New Orleans Mosquito & Termite Control Board
  - Dr. Claudia Riegel, Director
  - Sarah Michaels, Entomologist
  - Ed Foster, Pilot
- Manatee County Mosquito Control District
  - Mark Latham
- AMVAC Chemical Corporation
  - Peter Connelly
GAaP Trial – New Orleans, LA
Operational Trial – 27 July 2015

Trial Location

- New Orleans, LA – midtown area
  - Inner city location with raised housing and dense tree canopy
- Two test areas within an approximately 5,000 acre block
  - Test Area “A” – Marginy
  - Test Area “B” – Mid-City
- Both areas had monitoring records for many years
  - Citizen complaints and trap counts
GAaP Trial – New Orleans, LA
Operational Trial – 27 July 2015

Trial Location

Treatment Area A - Marginy

Treatment Area B – Mid-City
Aircraft Information

- Aircraft: Briton Norman Islander
- Insecticide Reservoir:
  - MicronAir 30 gallon “Pods”
  - One under each wing
- Spray Boom:
  - Two series of four flat fan SS8001 nozzles
  - Pressure: Approximately 60 psi
  - Flow Rate: 86 fl.oz. of Dibrom Concentrate per minute
- Application Delivery Guidance: Wingman®
- Information Management: AIMS
GAaP Trial – New Orleans, LA
Operational Trial – 27 July 2015
Aircraft Information
GAaP Trial – New Orleans, LA
Operational Trial – 27 July 2015

Application Information

- Application Date: 27 July 2015
- EPA Reg. No.: 5481-480
- Active Ingredient: naled
- Application Rate: 0.75 fl.oz. per acre (0.077 lb AI/A)
- Nozzles: 2X4 SS8001 (8 total nozzles)
- Aircraft Speed: 95 knots (109.3 MPH)
- Application Altitude: 200 - 450 feet (AGL)
- Swath Width: 500 feet
- Wind Direction: SSE
- Wind Speed: 7 to 15 MPH at release altitude
- Ambient Temperature: 84 to 86° F
- Relative Humidity: 55-65%
- First Pass Initiated: 8:02 PM (2002h)
- Final Pass Initiated: 8:43 PM (2043h)
GAaP Trial – New Orleans, LA
Operational Trial – 27 July 2015
Application Information – Flight Details

Wind At Altitude
SSE-S @ 7-15 mph

07/27/2015
NOMTCB - Aerial Spray trial
Britten-Norman Islander BN2A
Ed Foster
Dibrom 0.75 oz/Acre
Nozzles: 8 x FF8001 @ 80 psi
Flow Rate: 86 oz/minute
VMD approx. 80 microns

Spray Altitude 200-450 Feet (Obstruction Avoidance)
Average Altitude with Spray Switch on - 360 Feet
Spray Speed 95 Knots (110 MPH)
Swath Width 500 Feet
Offset Guidance Automated (WingMan/AMMS-20)

Meteorology (from AMMS-20 on Aircraft)
Wind: SSE-S @ 7-15 MPH
Temp: 86-84 F
Hum: 55-65%
Mosquito Bioassay Methodology

• *Aedes aegypti* and *Ae. albopictus* adults (F-1) reared from field collected populations
• 25 to 30 adult females per cage
• Cages consisted of cardboard tubing covered with tulle on both ends
• Number of Cages: 48 total cages – 24 *Ae. aegypti* and 24 *Ae. albopictus*
• Cage placement within each of the two test blocks
  • 6 cages of each species in open areas
  • 6 cages of each species in “sequestered” areas (dense tree canopy or under houses)
• Pre-application mortality assessment: At time of cage placement
• Post-application mortality assessments
  • 1 Hour (at time of pick-up before transfer to clean cage)
  • 24 Hours
• Untreated control mosquitoes
  • Both species, upwind of application, handling identical to treated mosquitoes
GAaP Trial – New Orleans, LA
Operational Trial – 27 July 2015
Mosquito Bioassay Methodology

Mosquito Cages
Cages placed in open and sequestered locations
GAAP Trial – New Orleans, LA  
Operational Trial – 27 July 2015

Species:  
- Ae. aegypti  
  - Open
  - Sequestered
- Ae. albopictus  
  - Open
  - Sequestered

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<th>Species</th>
<th>Exposure</th>
<th>Percent Mortality (24 h)</th>
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<td>86.6</td>
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Aedes aegypti and Ae. albopictus Mortality (n=11)
Trial Conclusions

- Naled is extremely effective against *Aedes aegypti* adults
  - 99.7 percent effective against *Ae. aegypti* exposed outdoors (n=11)
  - High levels of control in sequestered sites (89.8 percent: n=11)
- In this trial *Aedes albopictus* is slightly less sensitive to naled
  - Still achieved relatively high levels of control
  - 86.6 percent control in open sites (n=11)
  - 79.2 percent control in sequestered sites (n=11)
- Additional replications are required for confirmation of results
GAAP Trial – Miami- Wynwood
Operational Control Effort – September 2016

Miami Dade 2016

- Multiple applications of aerial naled
- Multiple applications of aerial larvicide
- 300,000 B.t.i Briquets in the storm sewer catch basins in Miami
- Applications of spinosad as larvicide
- Massive source reduction effort
- Comprehensive IPM
GAAP Trial – Miami- Wynwood
Operational Control Effort – September 2016

Wynwood Zika Activities Timeline

Total # of locally transmitted cases - 30
- Symptom Onset Date for Cases
- Notation: Cases with earlier onset dates are identified through active case finding. However, it is possible that these cases are not identified and are not reflected on the chart.

- Truck Adulticide Sprays - 8
- Truck Larvicide Sprays - 1
- Aerial Adulticide Sprays - 4
- Aerial Larvicide Sprays - 4

*Not pictured are day-to-day on the ground activities, such as source reduction and backpack spraying.*
Miami Dade 2017

![Graph showing data for AeDES Aegypti Adult Females in Miami Beach, FL. The x-axis represents dates from 08/21/2016 to 09/23/2016, and the y-axis represents the number of mosquitoes/trap/day. The graph indicates the use of different methods such as Truck Adulticide, Turck Adulticide, Truck Larvidide, and Aerial Adulticide.](image-url)
“Aggressive mosquito control efforts, including aerial adulticiding and larviciding, most likely contributed to a decrease in Zika virus transmission; no new cases in this area were identified with symptom onset more than 2 weeks after the first aerial adulticide and larvicide applications. The affected community also played a role in preventing new infections when residents and businesses began observing Drain and Cover prevention measures.”
Moving Forward

- Data published on Miami operational
- Data published on New Orleans operational
- Return to New Orleans in 2017
- Return to Blanding with C-130 or Rotary 2017
Thank you!
Current AMVAC Product Line
Focus on Public Health

Larvicides

Summit Bti Briquets™

Bacillus thuringiensis
subspecies israelensis

Larvae feed on very small particles in the water column close to the surface

- Catch basins & storm drains
- Ditches & ponds
- Swamps
- Woodland pools
- Drainage areas
- Water retention structures
- Lagoons
- Sediment ponds
- Filtration systems
- Wet wells and other sumps
- All man made and natural containers
Current AMVAC Product Line
Focus on Public Health

Nuvan® Prostrips
Nuvan® Prostrips +
Nuvan® Directed Aerosol
Nuvan® Fog 2EC
Nuvan® Fog 5% EC
Nuvan® Fog 4EC

Dichlorvos (DDVP)

Continuous, long-lasting protection from pests in difficult-to-reach areas such as attics, basements, crawl spaces, closets, pantries, sheds, garages and RVs. Effective against tougher, more common pests, such as ants, bedbugs, cockroaches, bees/wasps, pantry pests, flies and mosquitoes. NUVAN PROSTRIPS’ unique vapor action protects areas continuously for just pennies a day—with no odor or mess.
Current AMVAC Product Line
Focus on Public Health

Adulticides

Dibrom® Concentrate
Trumpet® EC
Naled

Dibrom Concentrate® and/or Trumpet EC® have been involved in assisting in public health emergencies for over five decades

No other adulticide product used before or since, has the history of performance, reliability and safety of Dibrom and Trumpet

Unique characteristics about this chemistry including; no known resistance, specific gravity of the AI, overall effectiveness, rapid breakdown in the environment.
Thank you!