Characterization and efficacy of VectoBac® WDG applications targeting container-inhabiting mosquitoes utilizing Unmanned Aerial Vehicles

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Co-Innovating Solutions for Container Mosquito Control - A WALS℠ Summit

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Container-breeding species in Collier County

- Wide-spread throughout District
- Pyrethroid-based insecticide resistance common in Colliers *Aedes aegypti* (Estep *et al*. 2018) and *Culex quinquefasciatus* (Lucas *et al.* 2020)
- Primarily targeted using liquid larvicide applications

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Liquid Larvicide at CMCD

- Buffalo Turbine & Liquid Larvicide unit for rotary wing aircraft in 2016 for ZIKV Response
- A1 – Superduty and two A1 – Rangers in 2019 to expand capabilities
- PrecisionVision Liquid Application System for UAV in 2019 for fine-tuned applications of smaller treatment areas

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Precision Vision (PV) 13 UAV

- Tank Capacity: 2.5 gallons
- Payload Capacity: 13 lbs
- Flight time: ~ 15-30 mins/battery

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Specifications

- Aircraft type: PV13 UAS
- Application rate: 0.5 lbs/acre (0.5 gal/acre)
- Flow rate: 40 oz/minute
- Nozzle type: 800067 (Fine/Extra Fine)
- Number of nozzles: 4
- Application height: 30 ft
- Speed: 10 mph

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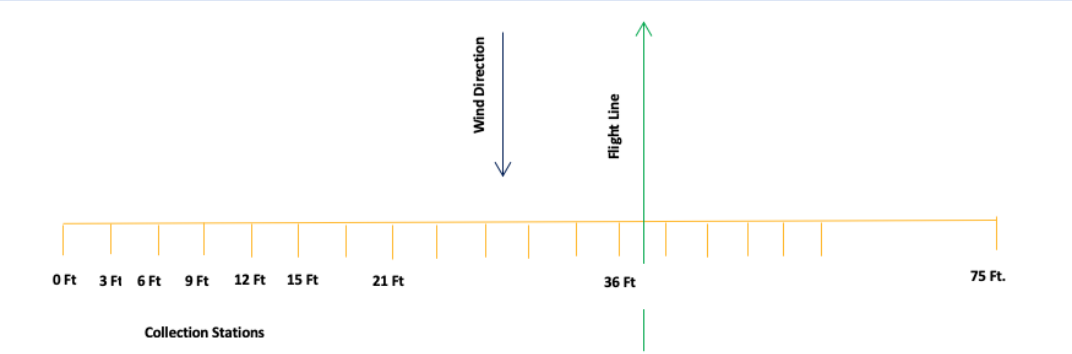
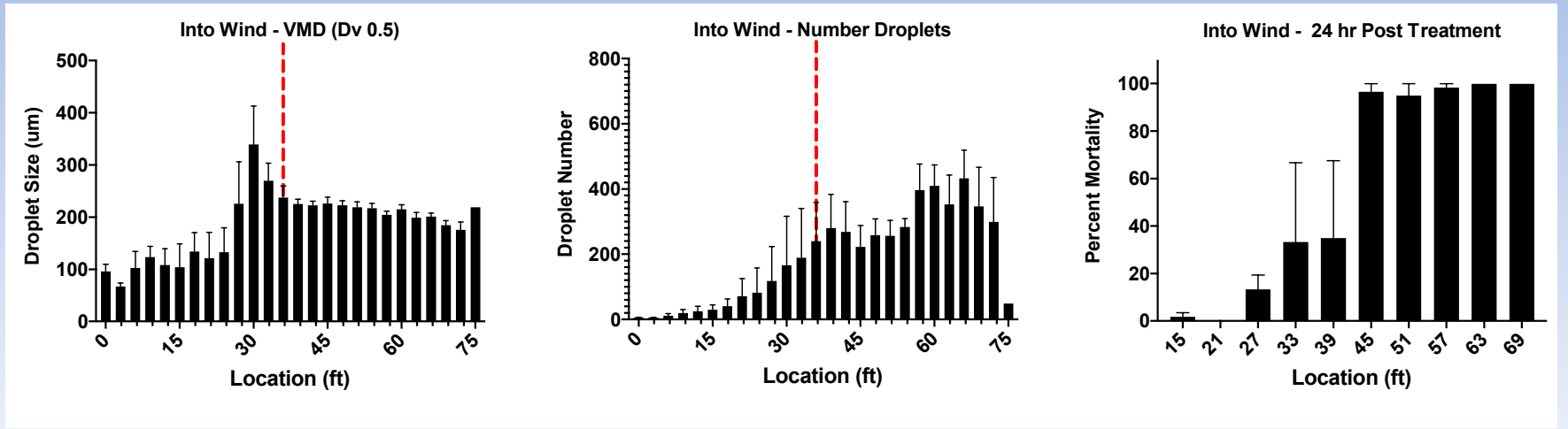
Effective Swath – Experimental Design (Into Wind)

- Kromakote card placed every 3 ft for 75 ft
- 1 larval assay cup placed ever 6 ft starting at 15 ft to 69 ft (10 total)
- 3 replicates each
- Kromakote cards analyzed by Valent Biosciences for droplet measurements using BacDrop™
- Larval Assays performed in-house
  - 100 mL dH2O and approximately 20 *Aedes aegypti* (ORL) larvae added to each assay cup
  - Larval counts determined at 0, 1, 24 and 48 hr post-treatment



”Into Wind” Design – Narrowest Swath



Lucas & Brake et al. (in press, JFMCA)

- Average VMD of 216.67 ± 4.78 across all three replications
- Droplet size was greatest near the flight line with larger droplets from 30-75 ft.
- Average drop number and drop density followed a similar pattern.
- Larval assays displayed mortality of greater than 90% between the 45 to 69 ft stations, indicating an effective swath of 24 ft on average.

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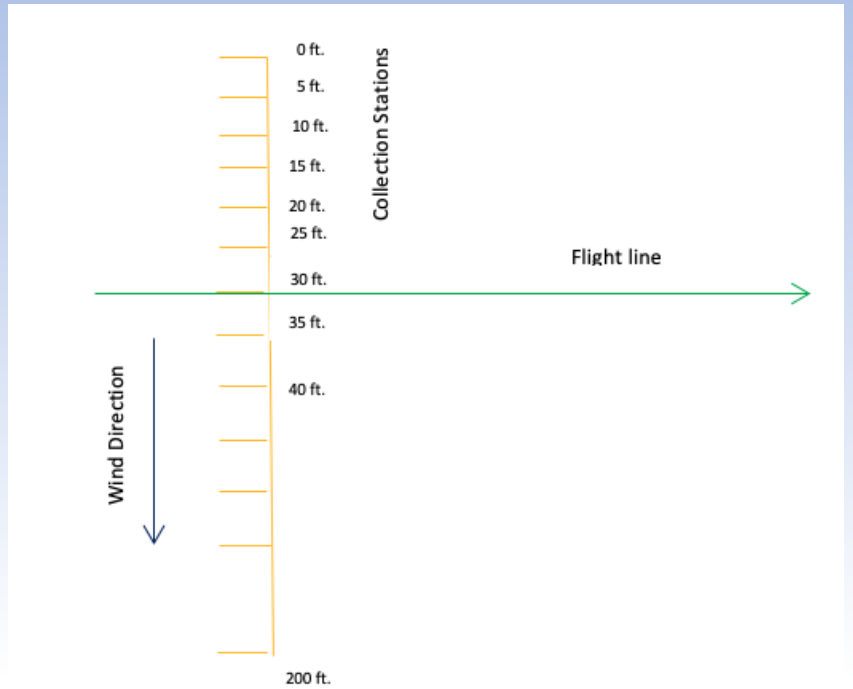
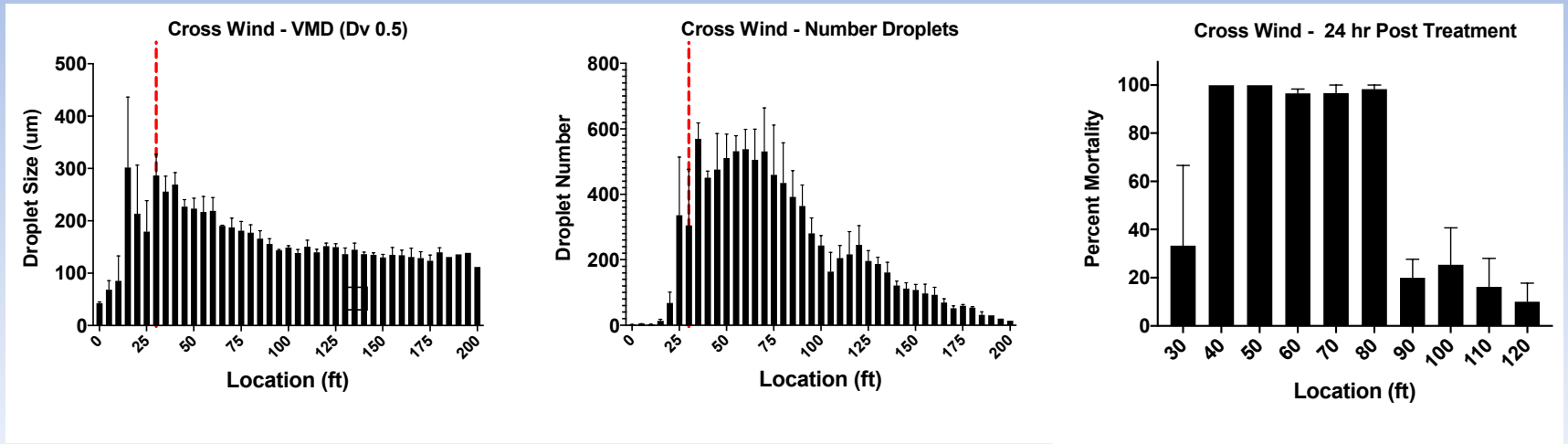
Effective Swath – Experimental Design (Cross Wind)

- Kromakote card placed every 5 ft for 200 ft
- 1 larval assay cup placed ever 10 ft starting at 30 ft to 120 ft (10 total)
- 3 replicates each
- Kromakote cards analyzed by Valent Biosciences for droplet measurements BacDrop™
- Larval Assays performed in-house
  - 100 mL dH2O and approximately 20 *Aedes aegypti* larvae added to each assay cup
  - Larval counts determined at 0, 1, 24 and 48 hr post-treatment



”Cross Wind” Design



Lucas & Brake et al. (in press, JFMCA)

- Average VMD (Dv 0.5) of 235.67 ± 22.95 across all three replications.
- Droplet size was also largest near the flight line with droplets extending beyond the 200 ft station
- Greatest number of droplets accumulating between the 30 ft and 90 ft stations
- Larval assays displayed mortality of greater than 90% between the 40 to 80 ft stations, indicating an effective swath of 40 ft on average.

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Semi-Field Trials – Experimental Design

- Larval Assays
  - 3 replicates
  - 10 larval cups placed within treatment block (some cryptic habitats)
  - 100 mL dH2O and approximately 10-20 *Aedes aegypti* larvae added to each assay cup
  - Larval counts determined at 0, 1, 8, 24 and 48 hr post-treatment

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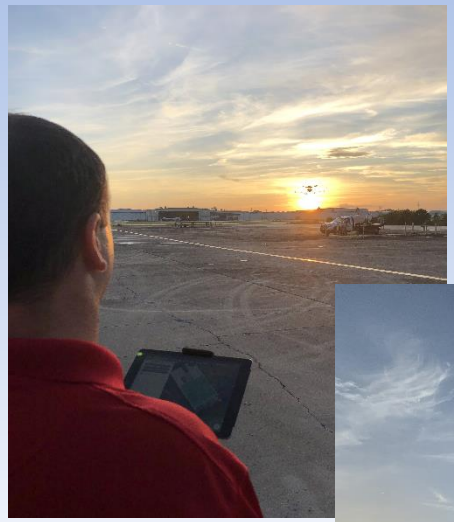
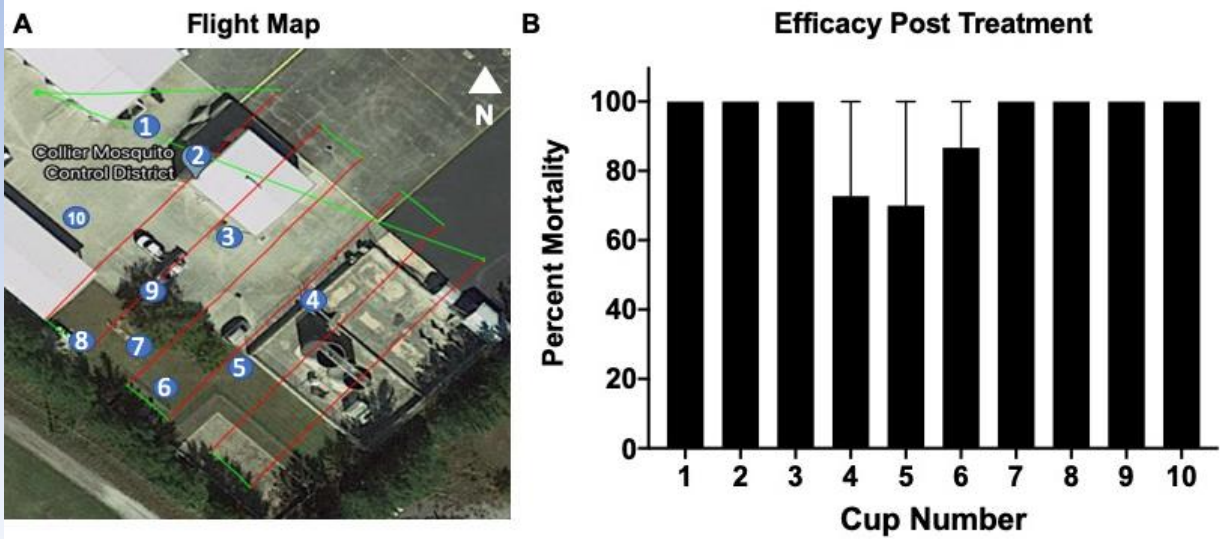
Semi-Field Trials – Experimental Design

Semi-Field Trials



Semi-field Trial



- Nearly 100% efficacy was achieved within 24 hrs post-treatment when compared to non-treatment controls, with the exception of the final replicate displaying reduced efficacy in cups 4-6

Lucas & Brake et al. (in press, JFMCA)

Operational Application

- Larval Assays
  - 10 larval cups randomly placed within treatment block (some cryptic habitats)
  - 100 mL dH2O and approximately 10-20 *Aedes aegypti* larvae added to each assay cup
  - Larval counts determined at 0, 1, 24 and 48 hr post-treatment
- Landing Rates
- Larval Dips
- BG-Trap

Operational Treatment

- One-acre treatment block in an urban industrial park.
- Habitat contained several larval habitats including tires, pallets, paint buckets, storage containers, PVC and large metal pipes, and trash bins. Abundant garbage and debris, with emergent vegetation.

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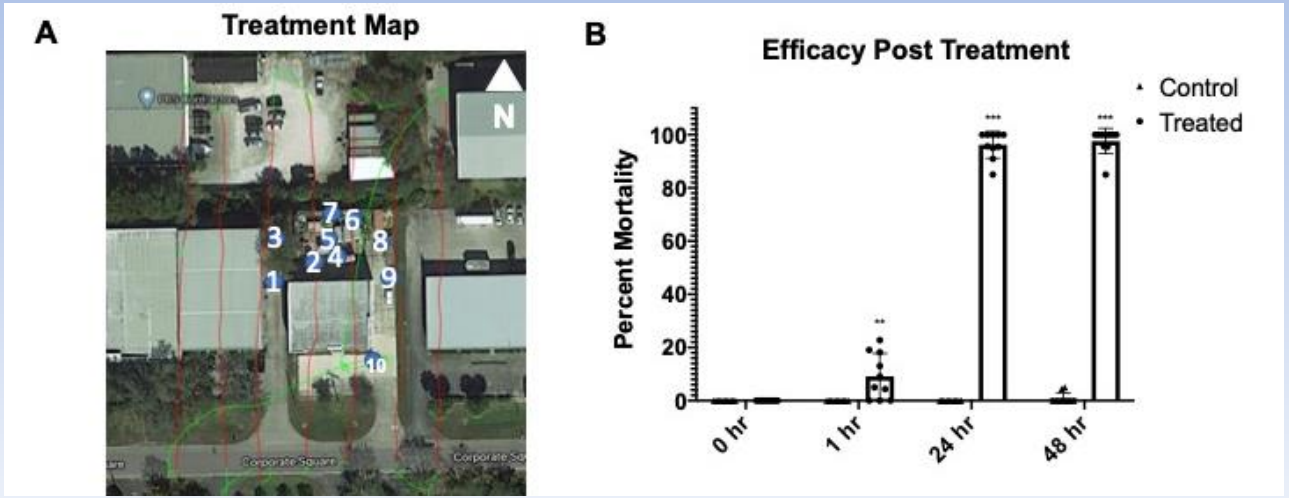
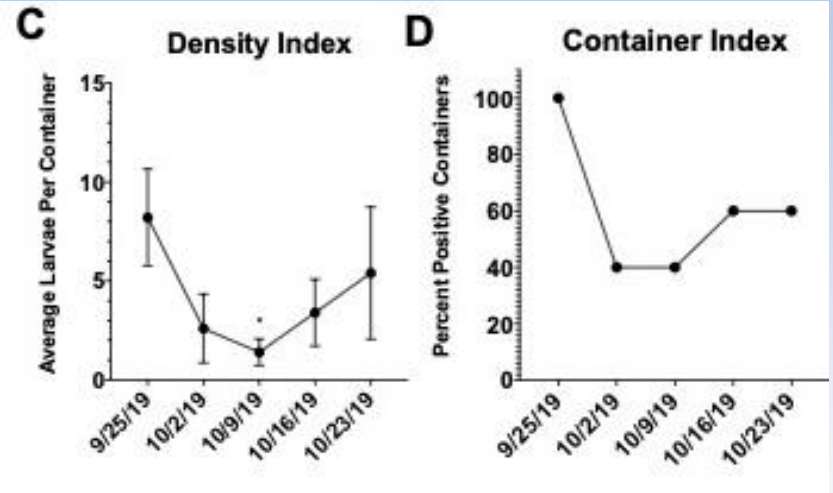
Operational Application



Lucas & Brake et al. (in press, JFMCA)

- Nearly 100% efficacy was achieved within 24 hrs and 48 hrs post-treatment.

Operational Application



Lucas & Brake et al. (in press, JFMCA)

- Larval density was lowest at 2-weeks post-treatment with larvae reestablishing by 4-weeks post-treatment
- By 1-week post-treatment, the percent of positive containers in the area reduced by 60% and remained low during the duration of surveillance activity in the area

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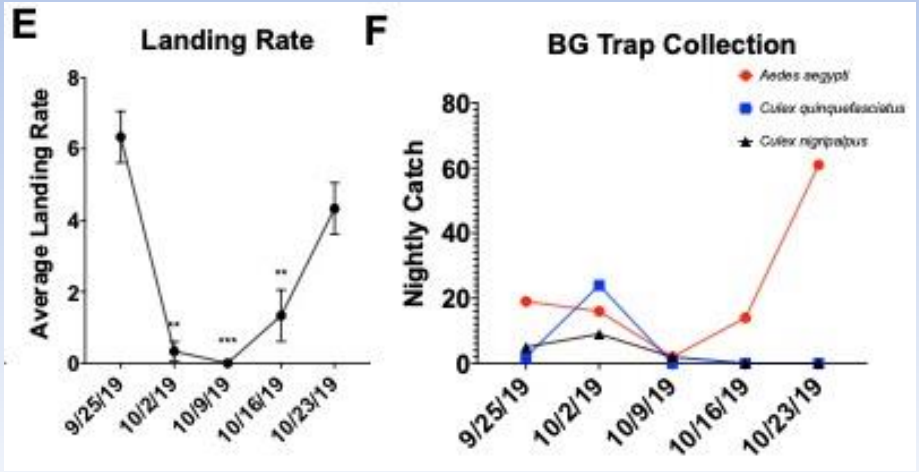
Operational Application



Lucas & Brake et al. (in press, JFMCA)

- Human landing rates (*A. aegypti*) were significantly reduced by 1-week post-treatment and remained low for 3 weeks, with the population reestablishing within 4-weeks post-treatment
- BG-Sentinel traps collections depicted a decreased trend in the container-inhabiting species *A. aegypti* and *Culex quinquefasciatus* by 2-weeks post-treatment, with the population reestablishing within 3-weeks post-treatment

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Conclusions

- *The UAS will work effectively for aerial WALS™ applications of VectoBac® WDG.*

- Under standard conditions, a flow rate of 40 oz/min, at 10 mph, swath of 30 ft and an application height of 30 ft was suitable for delivery of 0.5 lbs/acre to cryptic and exposed containers.

- A reduction in juvenile and adult container-inhabiting mosquito species was observed for up to 14-21 days post treatment.

- For adequate control of container-inhabiting mosquitoes using the PV13 UAV and VectoBac® WDG, the District should perform applications every 14-21 days in areas when/where applicable.

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Thank You

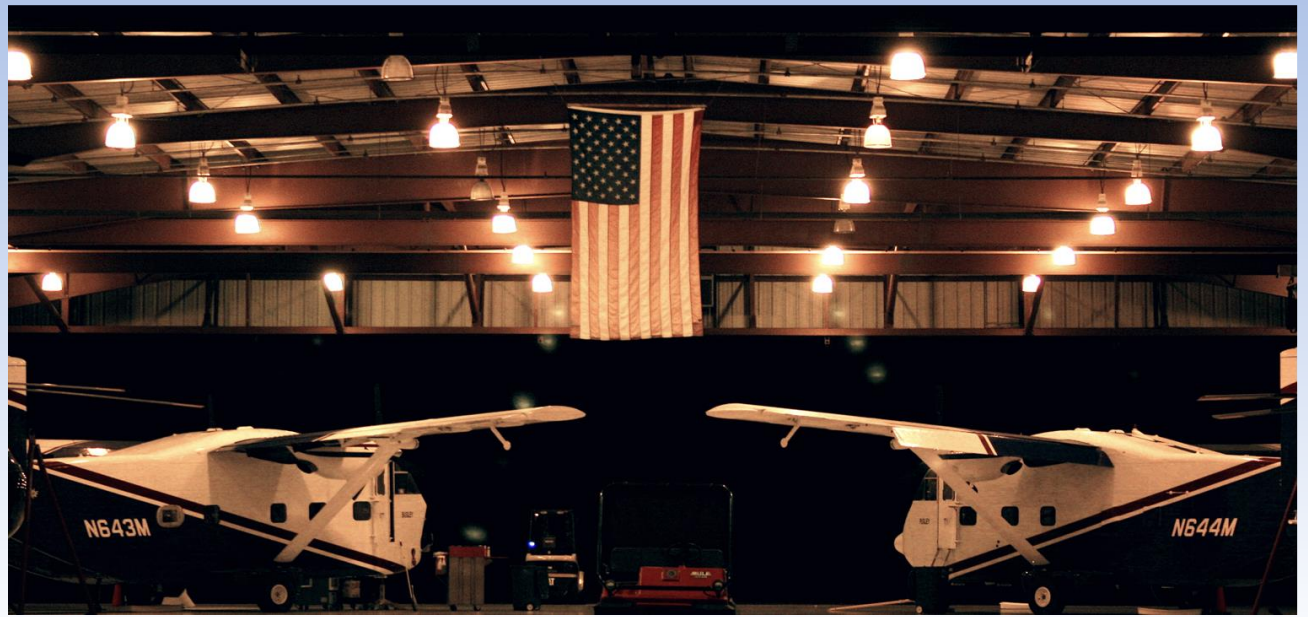
Collier Mosquito Control District

- Executive Director: **Patrick Linn, MS, MSHAPI**
- Chief Operations Officer: **Nate Phillips**
- Director of Technical Development: **Peter Brake**
- Field Technician Supervisor: **Richie Ryan**
- Biologist: **Rachel Bales**
- Technical Development Intern: **Sara Grant**
- Board of Commissioners: **Jacquelyn D. Thompson-Fresenius; David H. Farmer; Michael V. Reagen, PhD; Sandra Lee Buxton; John Johnson**

Valent Biosciences

- **Leanne Lake**
- **Candace Royals, MPH**

Questions



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