



**HORIZON-MSCA-2021-SE-01-INOVEC**



The potential of drones for releasing  
sterilised *Aedes* mosquitoes

**Rafael Argilés, MAPA Technology**

**Kick-off Meeting, Wednesday 15 February 2023  
(Presential & Virtual meeting)**

**GRANT AGREEMENT No 101086257**

**This project has received funding from the European Union HORIZON-MSCA-2021-SE-01**

# Status of the SIT Technology for Aedes control

1. Development of the technological package
2. Pilot projects and demonstration of feasibility
3. Upgrade to operational programmes

**Current cost for production of 1 sterile male of:**

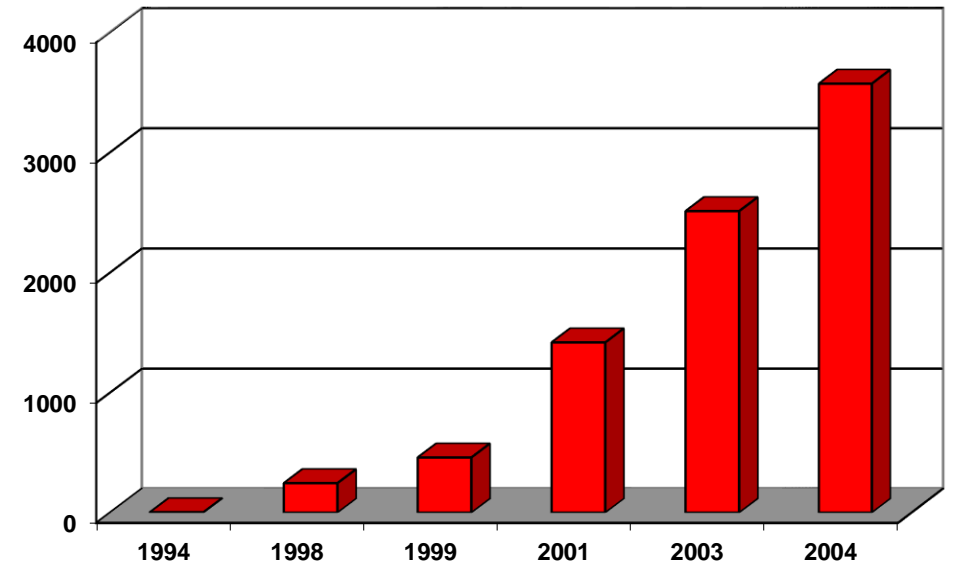
***Ceratitis capitata*: 0.03 cents of €**

***Aedes albopictus*: 30 cents of €** **X 1,000**



**Evolution of the production capacity of fruit fly sterile male for SIT programmes**

Millions of sterile males per week



Fuente: Hendrichs, J., et al. "Medfly areawide sterile insect technique programmes for prevention, suppression or eradication: the importance of mating behavior studies." *Florida Entomologist* 85.1 (2002): 1-13.

## ROBOTS AND SOCIETY

## Field performance of sterile male mosquitoes released from an uncrewed aerial vehicle

J. Bouyer<sup>1\*†‡</sup>, N. J. Culbert<sup>2,3‡</sup>, A. H. Dicko<sup>4,5</sup>, M. Gomez Pacheco<sup>6</sup>, J. Virginio<sup>6</sup>, M. C. Pedrosa<sup>6</sup>, L. Garziera<sup>6</sup>, A. T. Macedo Pinto<sup>6</sup>, A. Klaptocz<sup>4</sup>, J. Germann<sup>4</sup>, T. Wallner<sup>2,4</sup>, G. Salvador-Herranz<sup>4,7</sup>, R. Argiles Herrero<sup>2</sup>, H. Yamada<sup>2</sup>, F. Balestrino<sup>2,8</sup>, M. J. B. Vreysen<sup>2</sup>

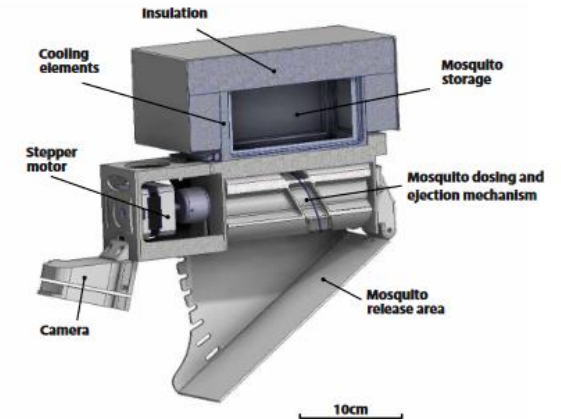
## Main results

- Prototype fine tuned based on multiple indoor and outdoor tests
- Validated during field trial in (Petrolina) Brazil in March 2018:
  - very good coverage of the release area, ratio of sterile to wild males 3
  - egg sterility > 50%, competitiveness > 0.3

A



B



C



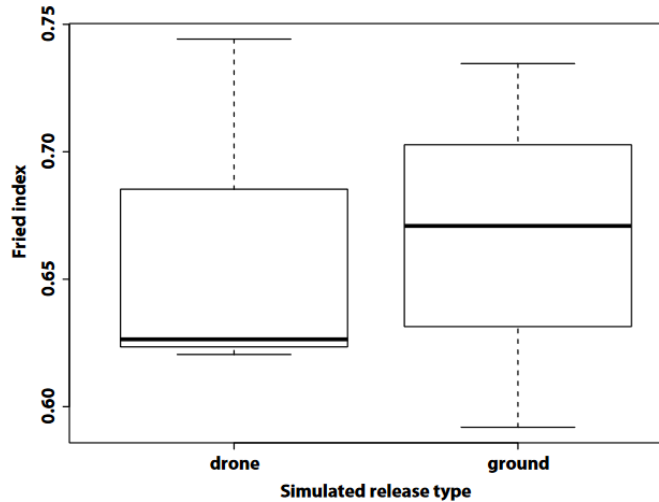
D



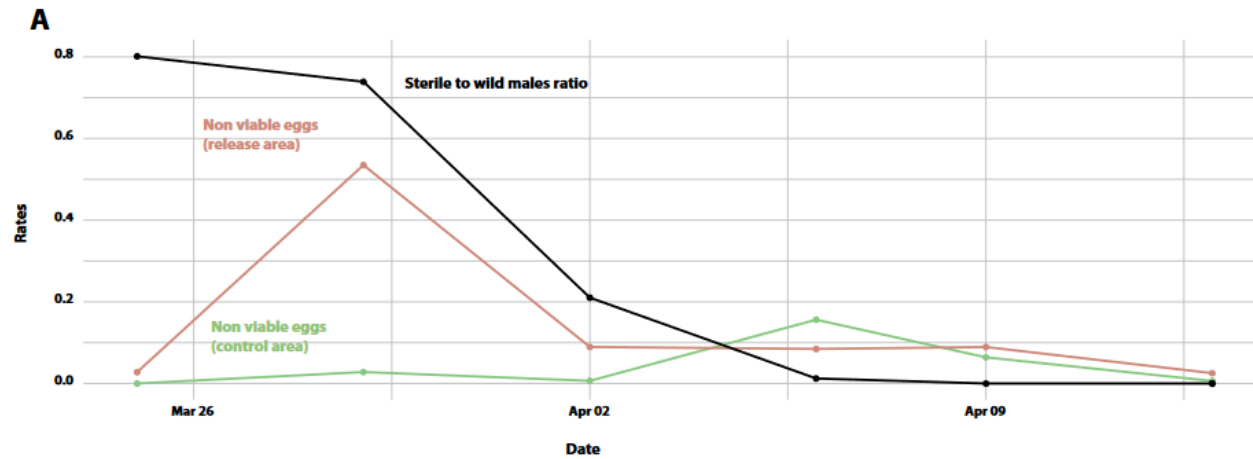
ROBOTS AND SOCIETY

# Field performance of sterile male mosquitoes released from an uncrewed aerial vehicle

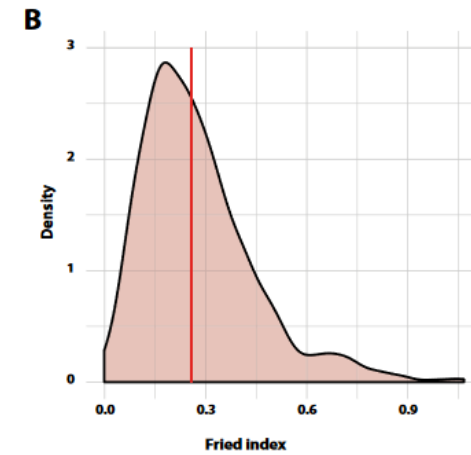
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**Fig. 2.** Fried competitiveness index of sterile male *A. aegypti*. Sterile males were released using our prototype aerial release system or by ground in large cages in the laboratory.



**Fig. 5.** Induced sterility and sexual competitiveness of sterile male *A. aegypti* released from an UAV-operated release system. **(A)** Temporal dynamics of the sterile-to-wild male ratio and rate of viable eggs in the release and nontreated areas. **(B)** Estimation of the Fried index from 1000 bootstraps in the distributions of sterile to wild male ratios in traps and viable egg rates in ovitraps in the release and nontreated areas (see the Supplementary Materials for details). The density corresponds to the percentage of the simulations for a given value.





Fourth Research Coordination Meeting on Mosquito Handling, Transport, Release and Male Trapping Methods



Release of *Aedes aegypti* sterile males through two methods in a pilot community in Chiapas, Mexico

Carlos F. Marina, Guillermo Bond, Roberto Angulo, Ariane Dor and Pablo Liedo



Developing a high effective system to transport and release *Aedes albopictus* mosquitoes in China

Xiaoying Zheng Dongjing Zhang

Wei Qian Cui Yang & Xi Zhiyong

SYSU-MSU Joint Center of Vector Control for Tropical Disease, Sun Yat-sen University, Guangzhou, P.R. of China



- Capacity: 0.8-1 M
- Target area: 22 Ha
- Time: 4 mins

The new drone regulation is based on risks. We want to explore the possibility of releasing mosquitoes within the OPEN category, **that doesn't require special flight permit**

### OPEN

- low risk
- No pre-approval envisaged
- Max 25 kg, VLOS, max altitude
- Rules:
  - no flight over crowds,
  - pilot competence



### SPECIFIC

- increased risk
- Approval by NAA based on Specific Operation Risk Assessment (SORA) performed by the operator
- Manual of Operations mandatory
- Mitigating measures



### CERTIFIED

- Regulatory regime similar to manned aviation
- Full aeronautical certification process
  - Certification of airworthiness, ...

**Very, very expensive**



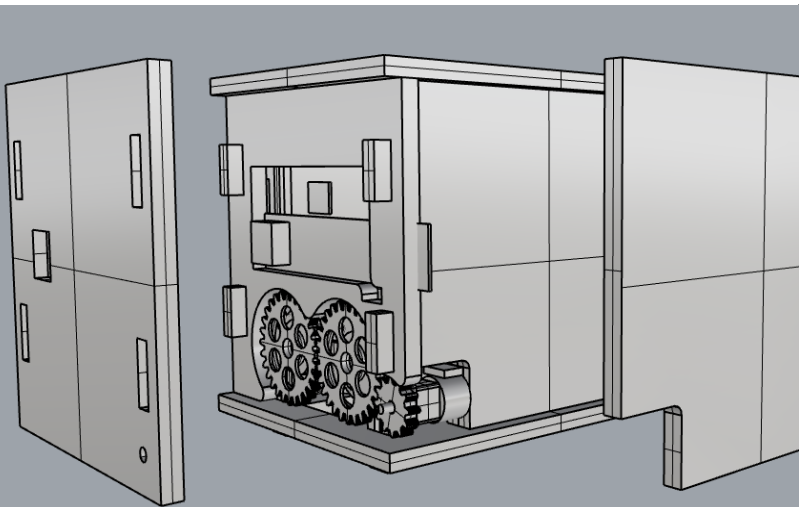
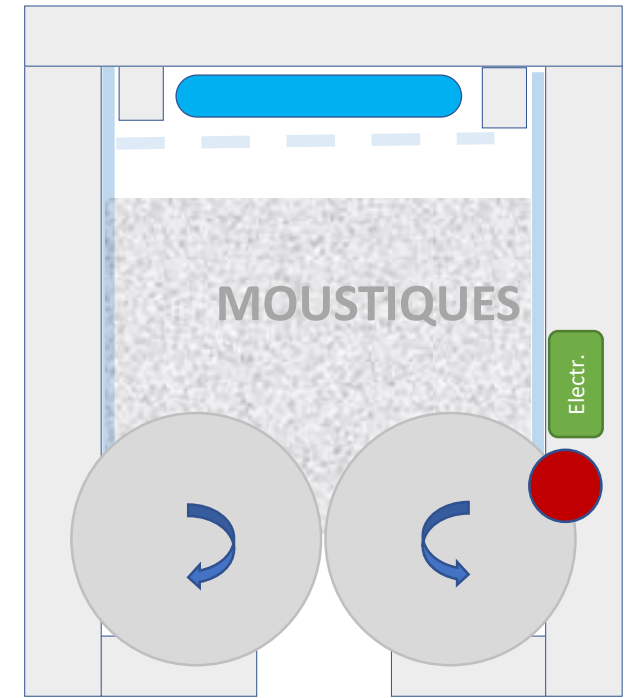
# Open Sub-Categories

UAS subcategory	UAS class	MTOM/ Joule (J)	Distance from people	Maximum height of the operation	Remote-pilot competence	Age of the remote pilot	Main technical requirements (CE marking)	UAS registration	Electronic identification, geofencing
A1 Fly over people	Privately built	< 250 g	Fly over uninvolved people (not over assemblies of people)	< 50 m	Leaflet	No limitation	N/a	No, if without camera of > 5 MP or an audio sensor	No
	C0						Directive 2009/48/EC, no sharp edges, awareness leaflet		
A1 Fly over people	C1	< 80 J or 900 g	Fly over uninvolved people (not over assemblies of people)	< 50 m < 120 m or up to 50 m above a higher obstacle, at the request of the owner of the object	Leaflet Leaflet plus online training with a test	14 years or with supervisor	Kinetic energy, no sharp edges, selectable height limit, awareness leaflet	Only for operator	If required by the zone of operations
A2 Fly close to people	C2	900 g to 4 kg	Fly intentionally in proximity to but at a safe distance from uninvolved people (> 20 m for rotary-wing UAS or > 50 m for fixed-wing UAS)	< 120 m or up to 50 m above a higher obstacle, at the request of the owner of the object	Leaflet plus CoC (theoretical qualification) and exam in an approved centre	16 years or with supervisor	Mechanical strength, lost-link management, selectable height limit, awareness leaflet	Operator and UA	Yes
A3 Fly far from people	C3	< 25 kg	Fly in an area where it is reasonably expected that no uninvolved person will be present	< 120 m or up to 50 m above a higher obstacle, at the request of the owner of the object	Leaflet plus online training with a test	16 years or with supervisor	Lost-link management, selectable. height limit, awareness leaflet	Operator and UA	If required by the zone of operations
	C4		In addition to the above, keep a safety distance from the boundaries of congested areas of cities, towns or settlements, or aerodromes				Operational. Instructions, awareness leaflet		
	Privately built						N/a		

We want to fly in the city over uninvolved people without the need of a specific authorization; therefore we need to design a system (drone+release machine) with a **MTOW < 900 g** and operate in **Visual Line of Sight (VLOS)**

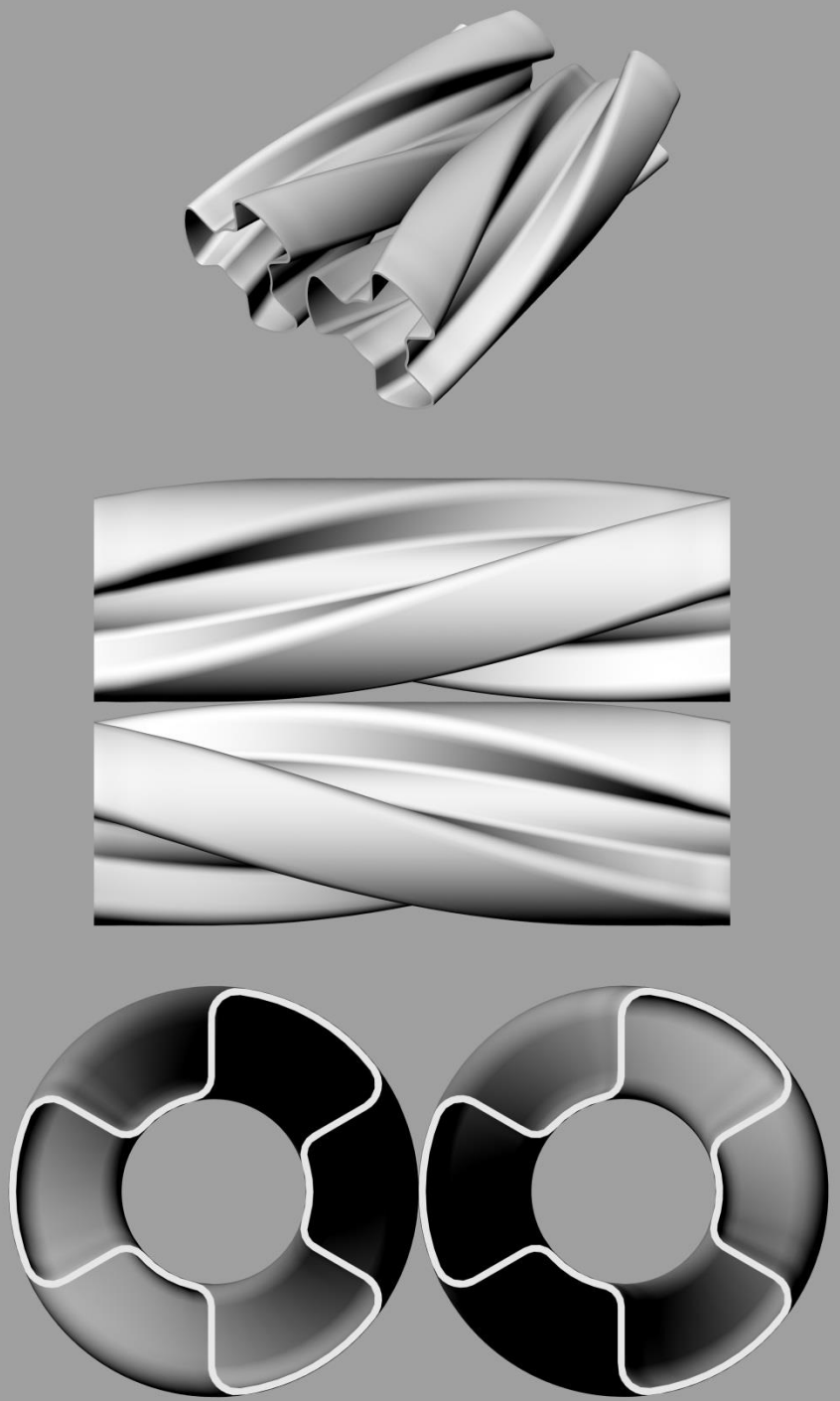
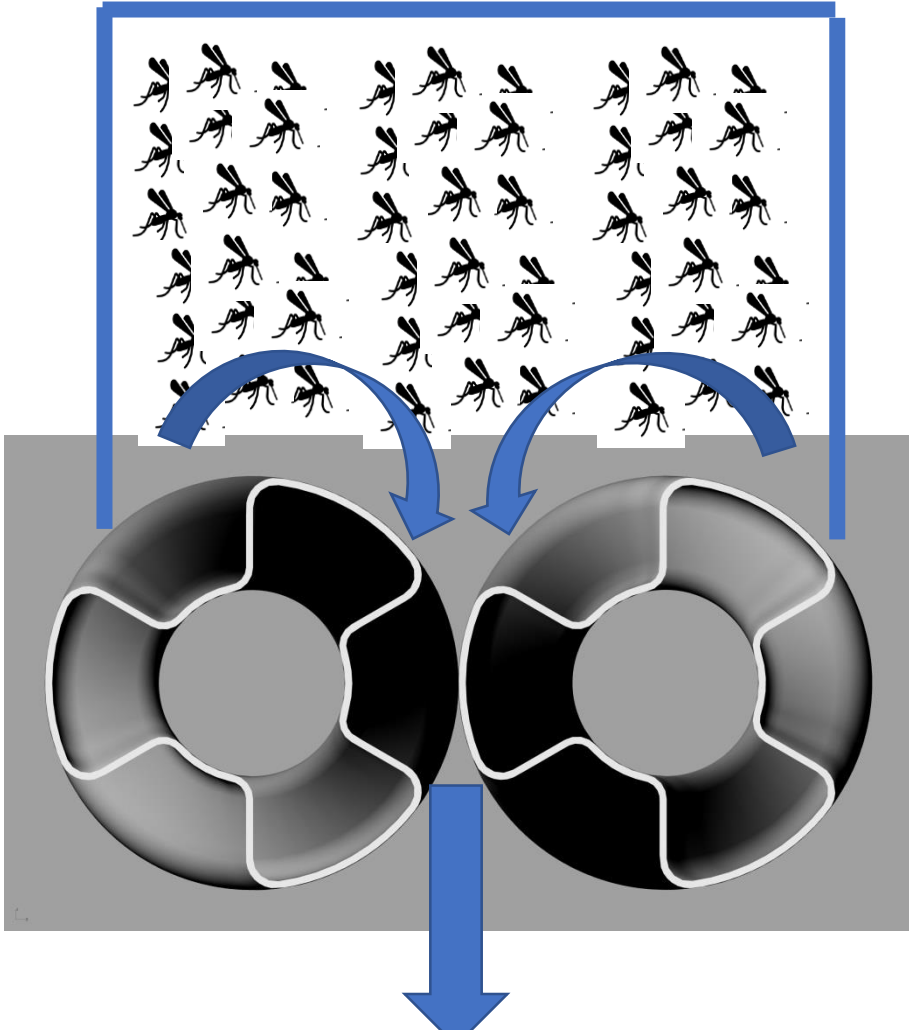
# Light Mosquito Release Machine

- **Light** mosquito release machine with **automated flow** releases at **predefined** coordinates.
- Works **independently** from the drone (both for power supply and for gps data).
- The dosage system causes **minimal mechanical damage** to the mosquitos
- After each flight, a **tracklog with the telemetry** of the flight (position, release speed, temperature and humidity) is created and can be downloaded from a microSD card



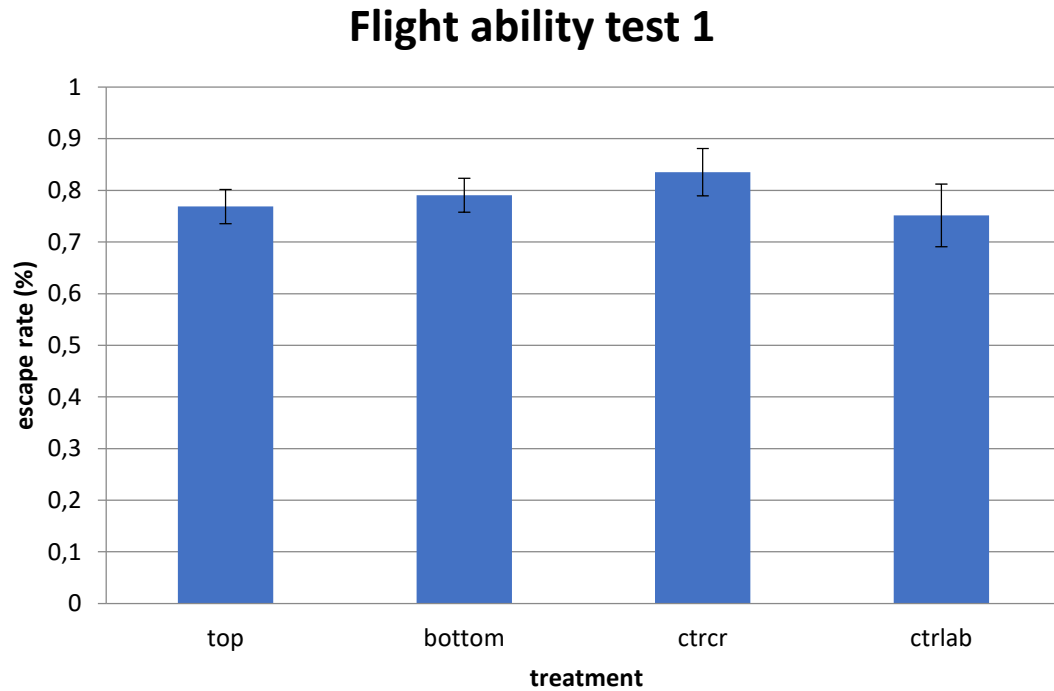


**Dosing mechanism: 2 cylinders with an helix shaped groove rotating in opposite directions**



# Minimal mechanical damage to mosquitoes

Quality of released mosquitoes measured as escape rate in the flight ability test



Top ones were mosquitoes that remained after most of the males went through the release machine

Bottom males were the mosquitoes that were first released through the release machine after 1/10 of total mosquito weight were released

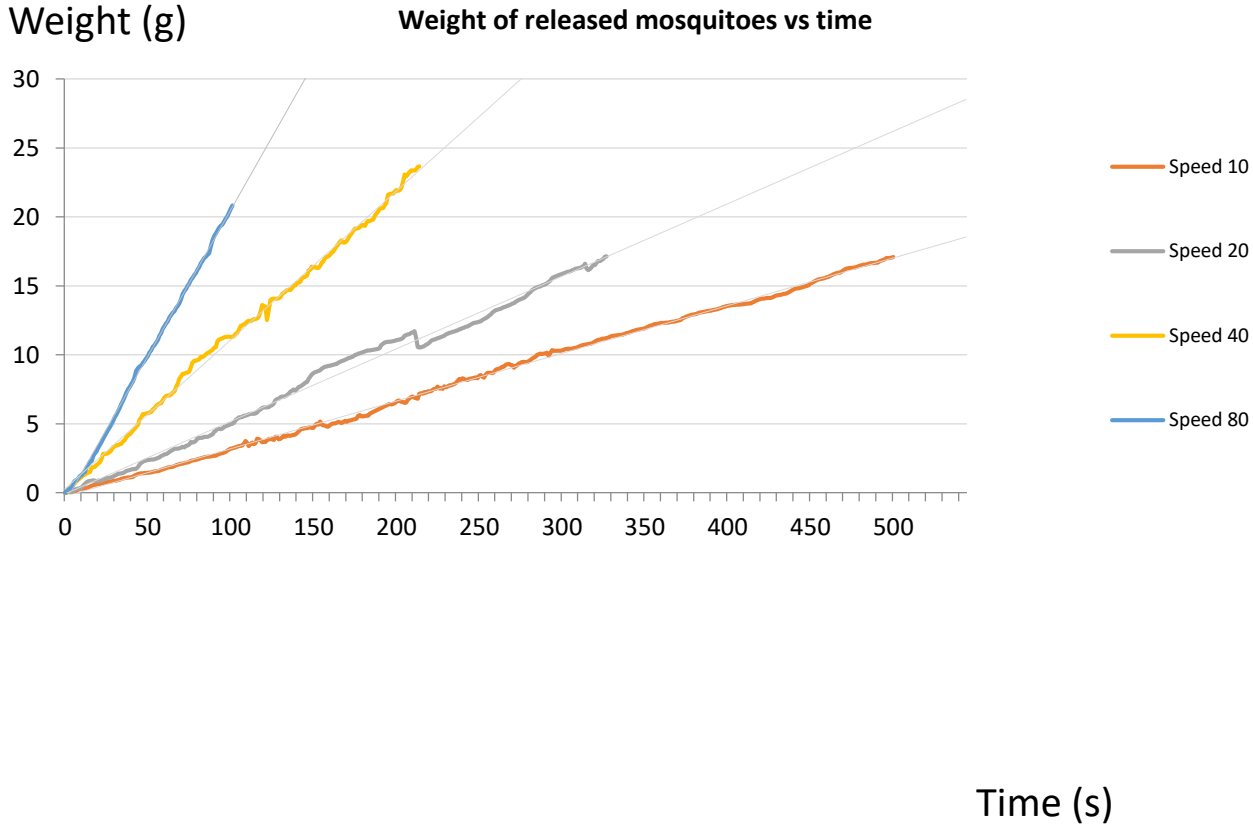
ctrl means control that was chilled/packed into the cold room during the release process.

ctrlab was group of mosquitoes that was not chilled / packed and were stored lab conditions



# Uniform release rates

Release rates uniformity tested with mosquitoes



Field experiences in Montpellier and La Réunion.

Results on dispersion and competitiveness in the field are pending publication



Dispositif de largage en cours de remplissage



Dispositif de largage vu de dessous



Drone (Potensic Dreamer Pro) et dispositif de largage au sol

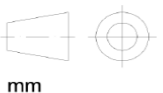
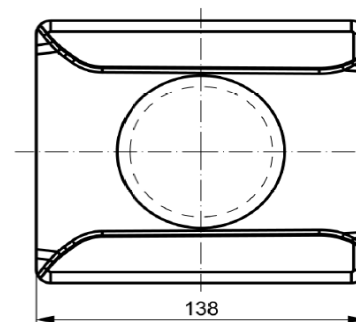
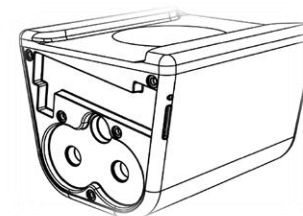
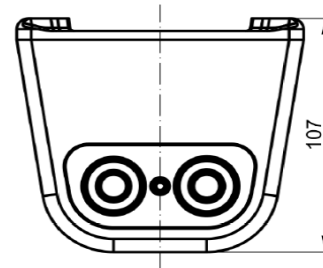
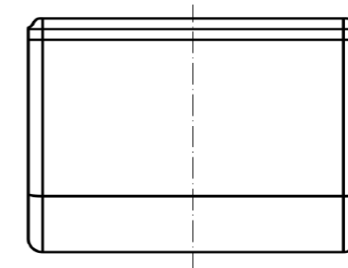
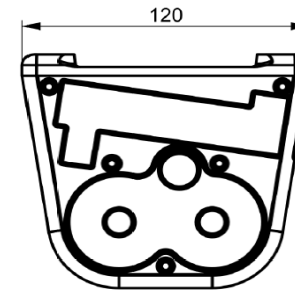


Drone (Potensic Dreamer Pro) avec dispositif de largage en vol

# Main features



1. Light release machine (200 g including the load of mosquitoes)
2. Automated release of predefined flows at predefined coordinates
3. Minimal mechanical damage to the insects
4. Capacity: 500 mL (around 40k mosquitoes) per flight
5. Track log file with telemetry
6. Independent of the drone
7. NO active cooling system.



**Thanks for your attention!**