

CHECK YOUR SOURCES

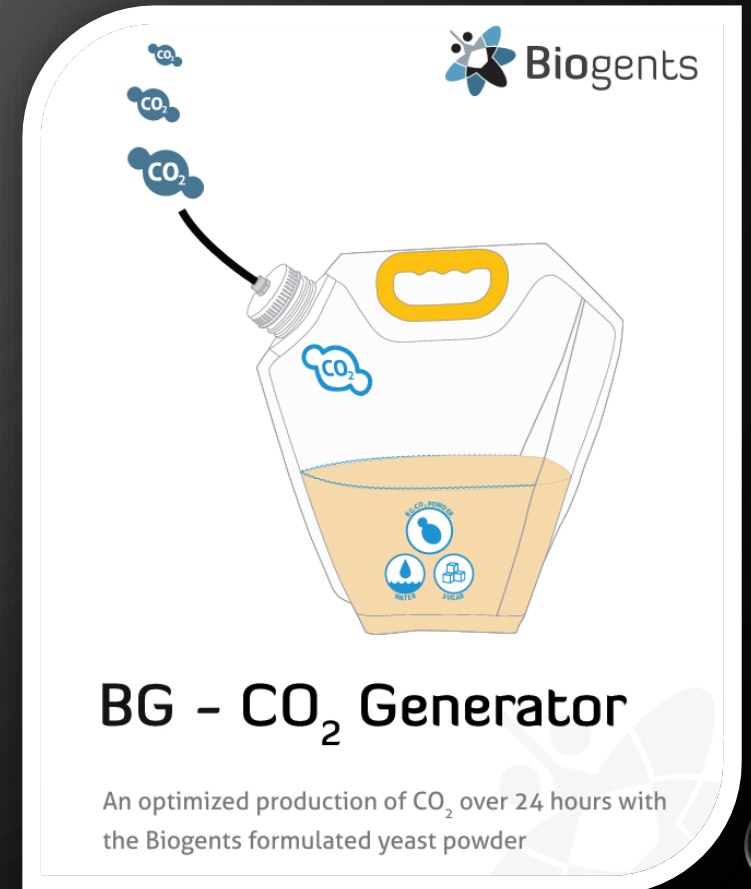
A LOOK AT CARBON DIOXIDE USE IN ADULT MOSQUITO TRAPPING



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Suffolk Mosquito Control

BACKGROUND

- AMCA 2023 – Biogents new product
- 2017 study in Suffolk
 - Aldridge et al. 2016 - yeast fermentation CO₂ generator
- One of the most expensive components of trapping
 - Traps, batteries, lures, parts
 - One-time, long-lasting, or relatively cheap
 - CO₂
 - purchased or made daily/weekly throughout the season
 - prices keep rising



WHY CO₂ ?

- Mimics animal respiration
- Attracts host-seeking mosquitoes
- Increases collection diversity and abundance



WHO CARES ABOUT THE SOURCE ?

- COLLECTION EFFICACY

- COST OF MATERIALS

- startup & annual costs

- MANPOWER/ERGONOMICS

- hazards, ease of use, maintenance

- RELIABILITY/AVAILABILITY

- supply chain shortages

HOW DO

STANDARD CO₂ SOURCES

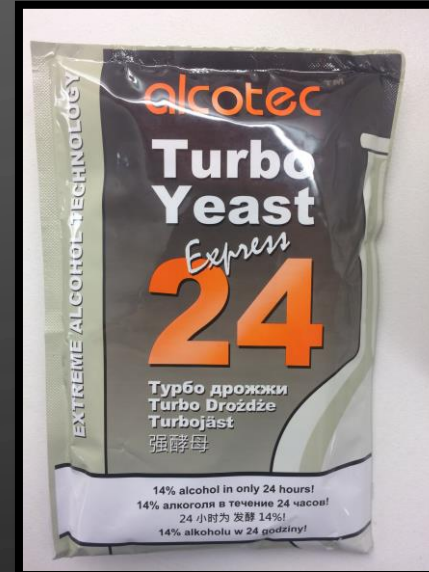
COMPARE TO ALTERNATIVES



COMPRESSED GAS
CYLINDERS
(TANK)



DRY ICE



YEAST
FERMENTATION



MUSHROOM
RESPIRATION

2017 CO₂ SOURCE STUDY

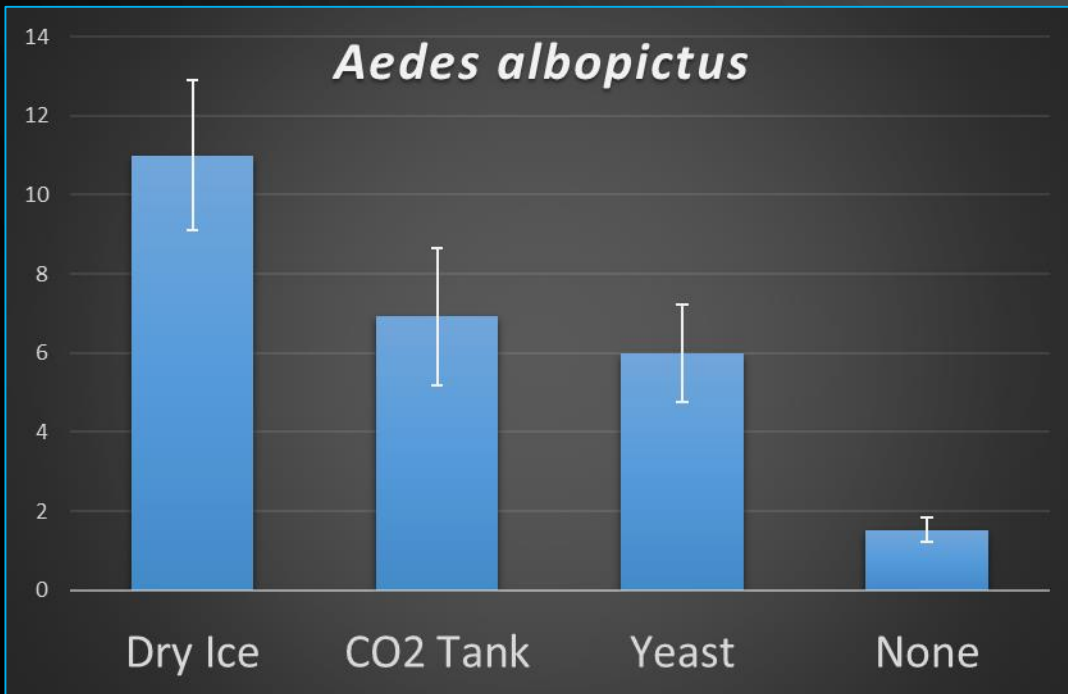
- Tank – Dry Ice – Yeast – Mushroom – None (Control)

Go
Shrooms!

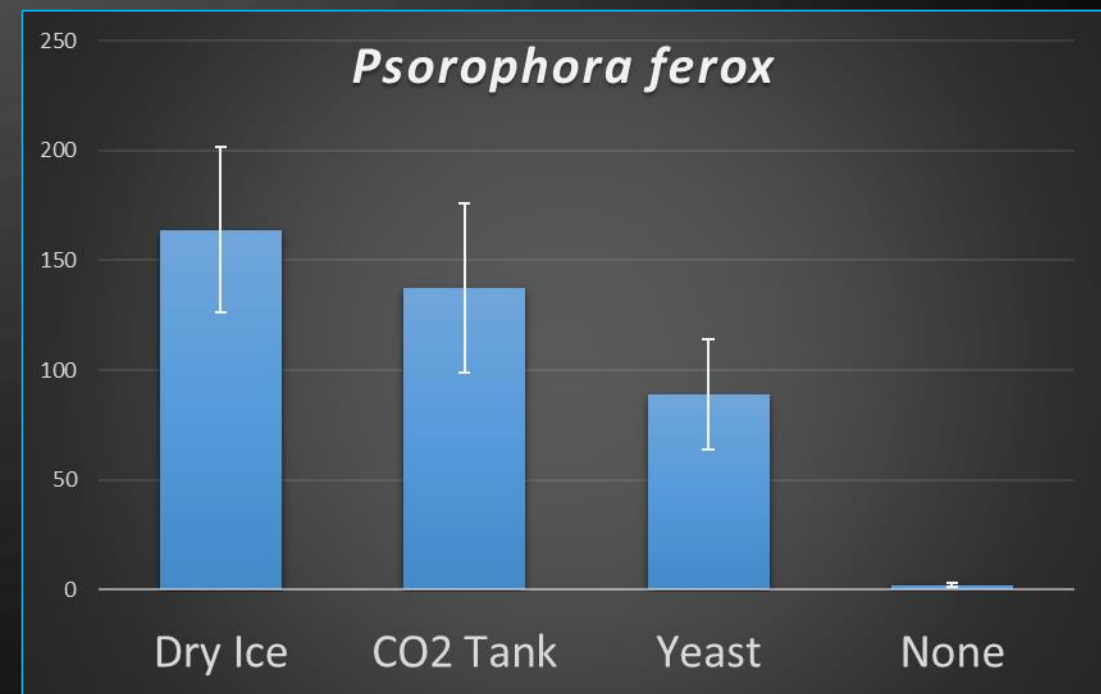


2017 CO₂ SOURCE STUDY

- Mushroom failed (excluded below)
- Yeast
 - not significantly different from Tank collecting *Ae. albopictus* or *Ps. ferox*



Average
females
collected
per trap
night

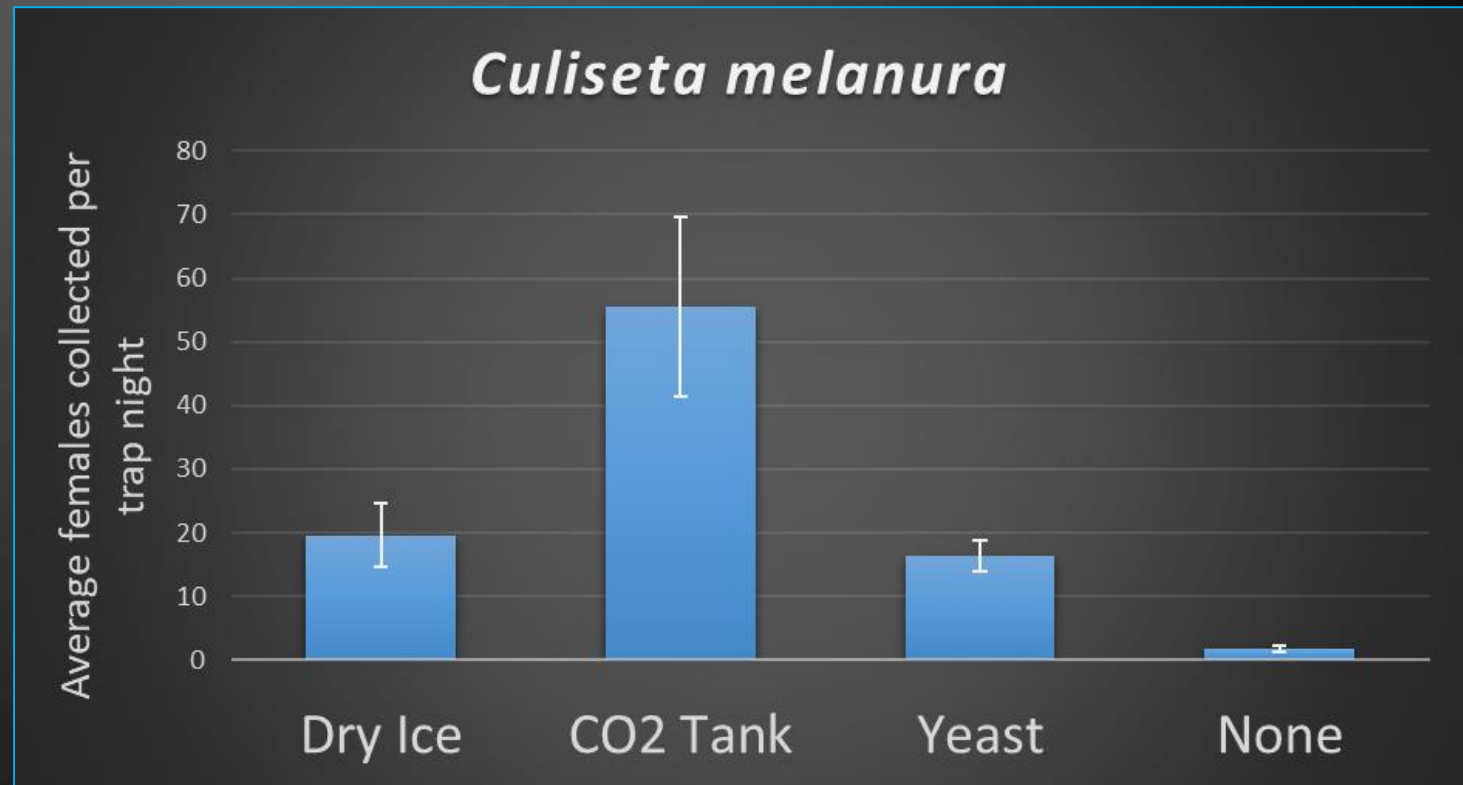


2017 CO₂ SOURCE STUDY

- Yeast

- Collected significantly less *Cs. melanura* than Tank

- HOWEVER, not significantly different from Dry Ice





SO WHAT'S THIS NEW YEAST

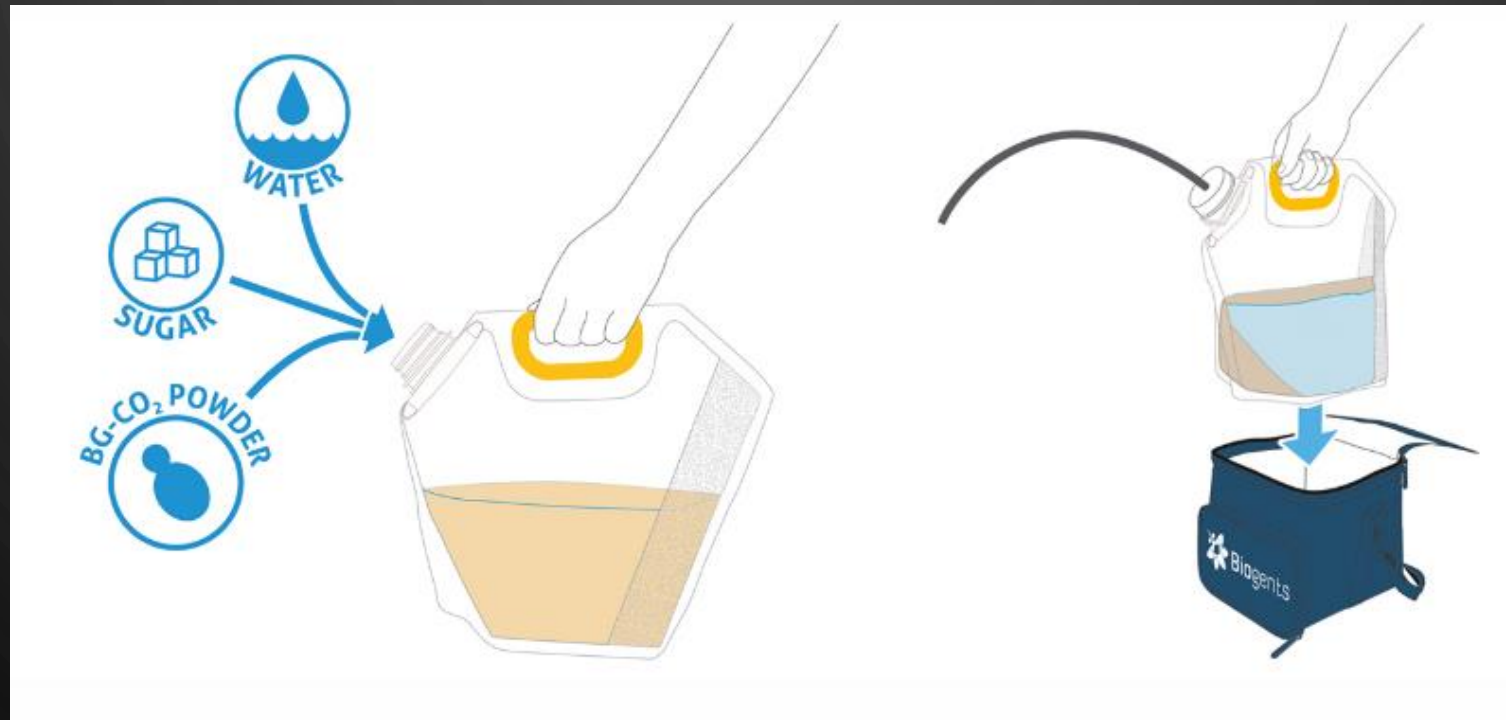
AND

HOW DOES IT PERFORM ?

BG-CO₂ GENERATOR

Mixture of multiple yeast strains and nutrients

Add sugar + warm water and mix



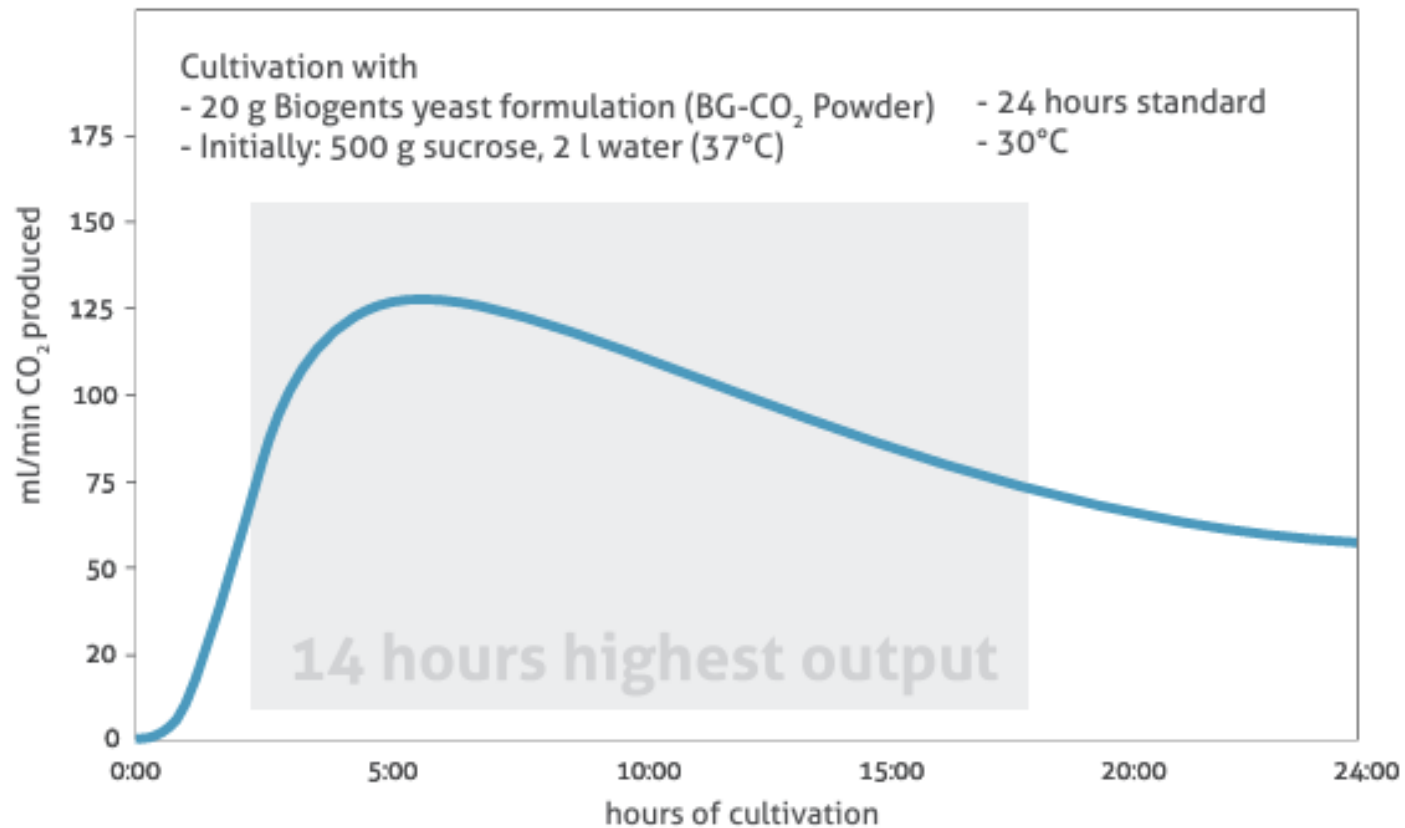
Insulated bag for stable temp

BG-CO₂ GENERATOR

Mixture of multiple yeast strains and nutrients

Add sugar + warm water and mix

Release rate of CO₂ over time of Biogents Yeast Formulation



Insulated bag for stable temp

Claims 24 hr monitoring

Highest output over 14 hr

2023 CO₂ SOURCE STUDY

Tank

Set to
200
ml/min



20 m



20 m

Yeast

As
directed



20 m



Ice

6.5 lb

- 4 x 4 Latin Square Design
- Tank – Dry Ice – Yeast – None (Control)
- BGS2 traps with lures, rain guards
- 16 trap nights, July-August

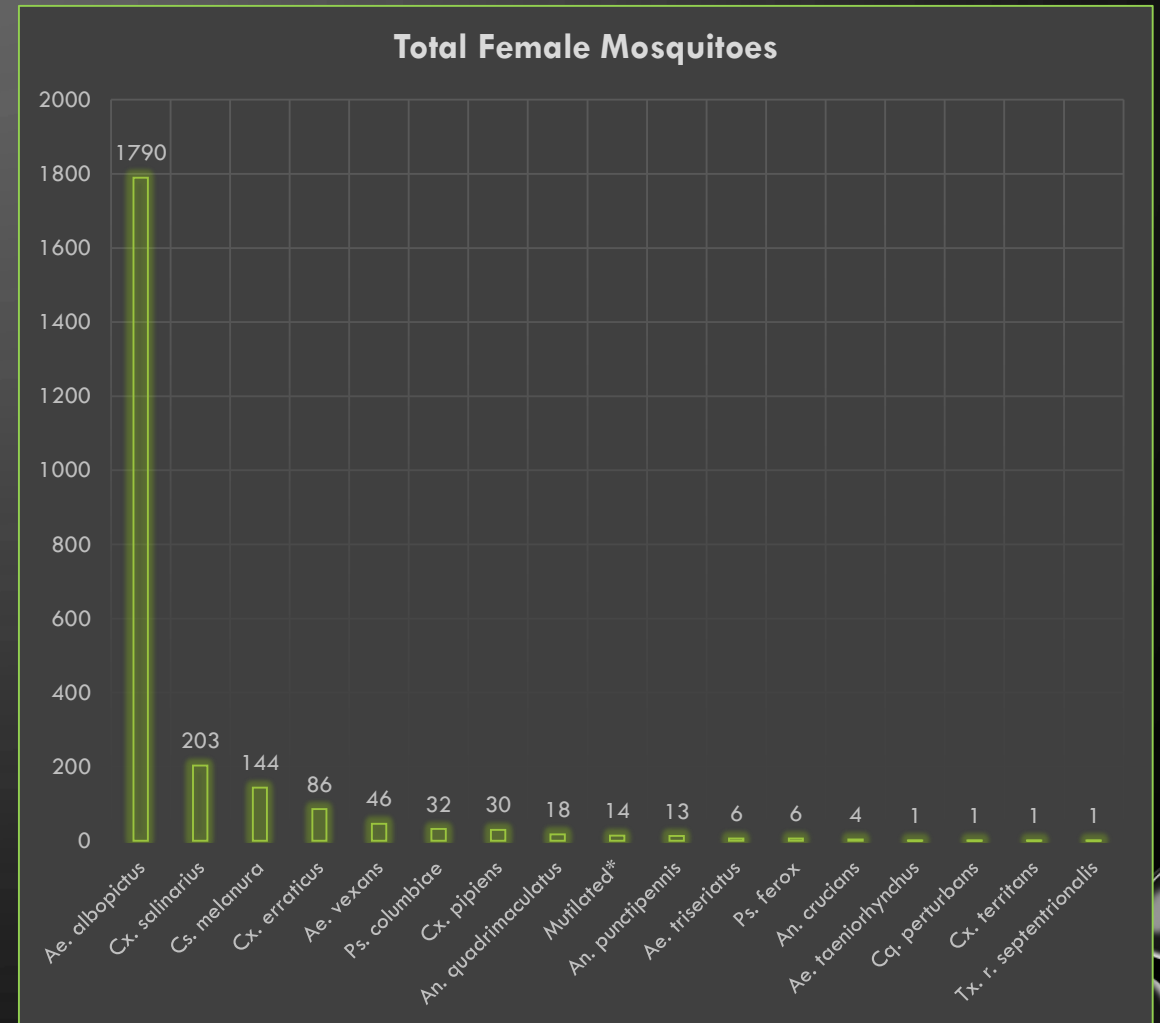
None



2023 CO₂ SOURCE STUDY

Results

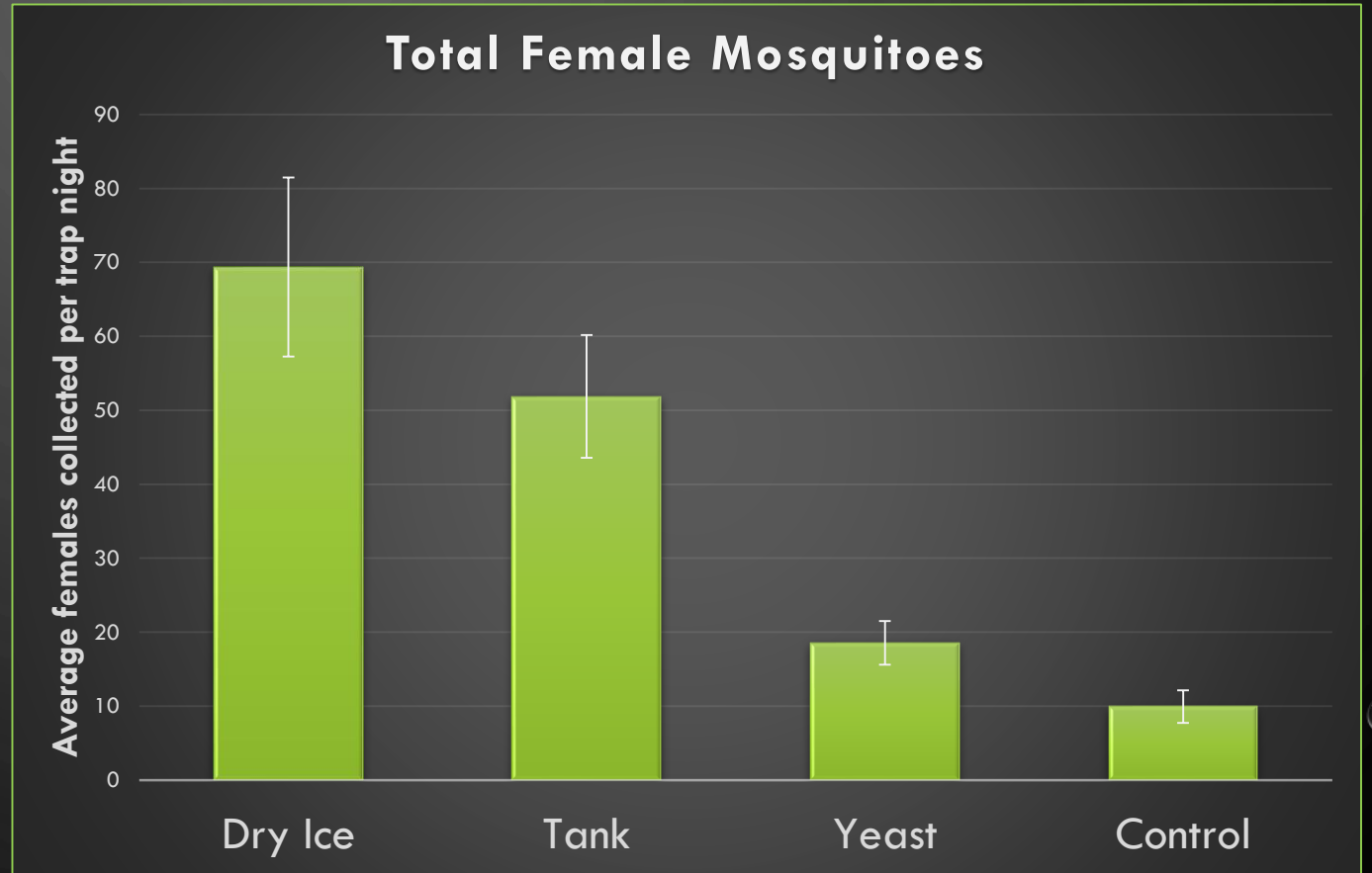
- Over 3,000 mosquitoes collected
- 937 males (99% *Aedes albopictus*)
- 2,396 females:
 - *Ae. albopictus* (75%)
 - *Cx. salinarius* (8.5%)
 - *Cs. melanura* (6%)
 - *Cx. erraticus* (3.6%)
 - Remaining 7% - 12 species, 6 genera



2023 CO₂ SOURCE STUDY

ANOVA, post-hoc t-tests for
Total Females:

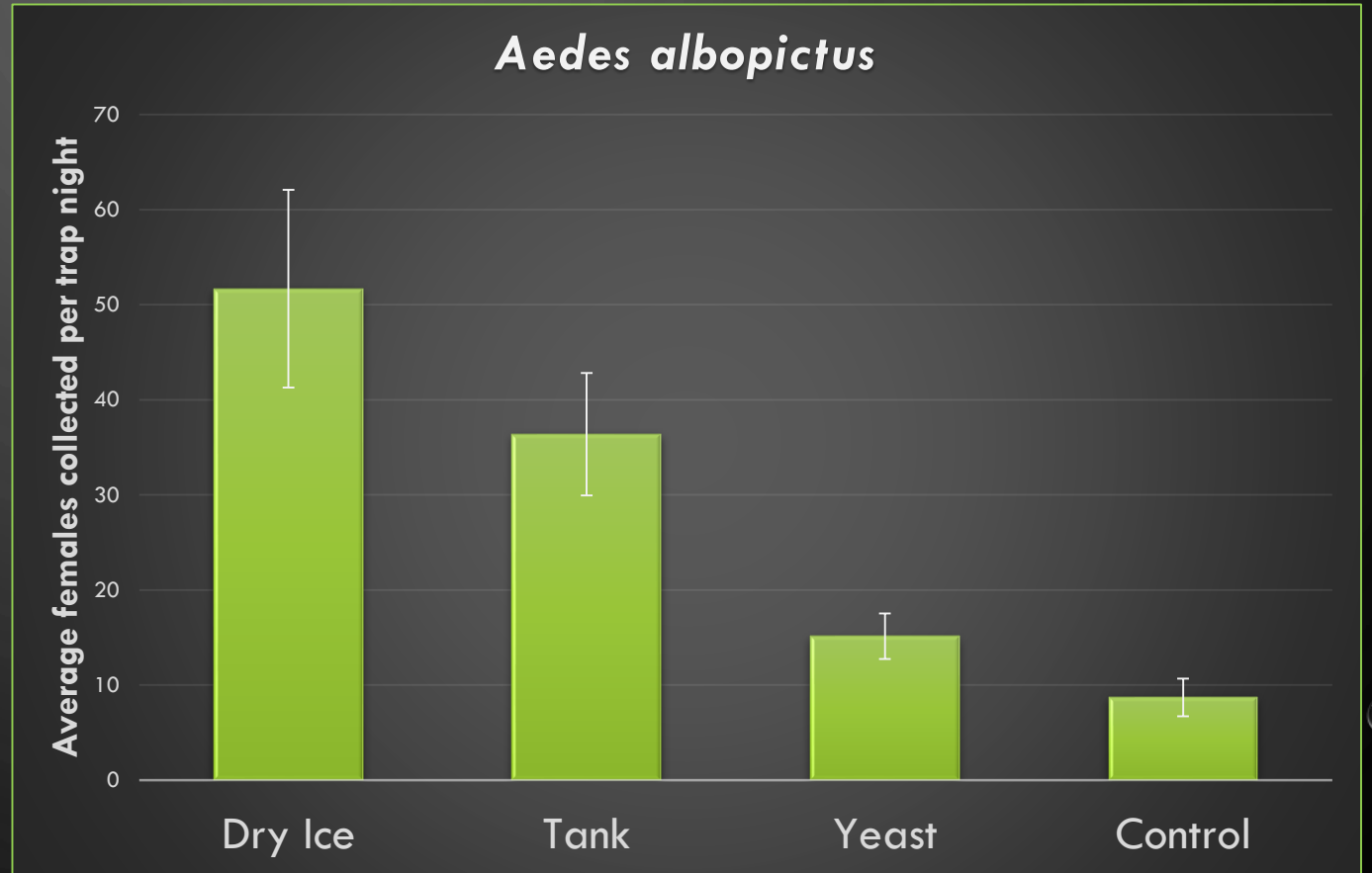
- Ice and Tank both significantly outperformed Yeast
- Yeast was better than nothing!



2023 CO₂ SOURCE STUDY

ANOVA, post-hoc t-tests for
Aedes albopictus:

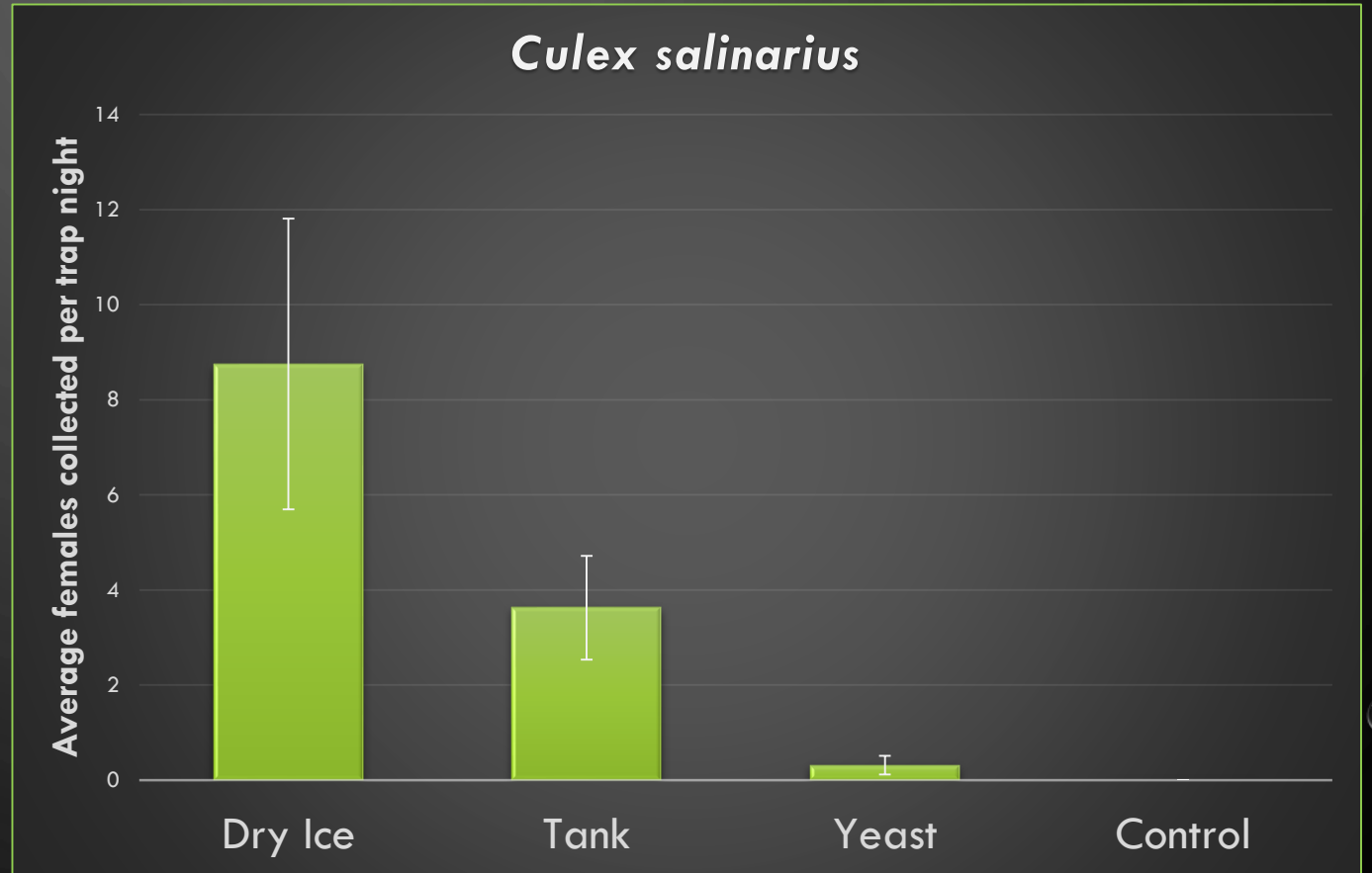
- Same results as Total Females
- Ice and Tank both significantly outperformed Yeast
- Yeast was better than nothing



2023 CO₂ SOURCE STUDY

ANOVA, post-hoc t-tests for
Culex salinarius:

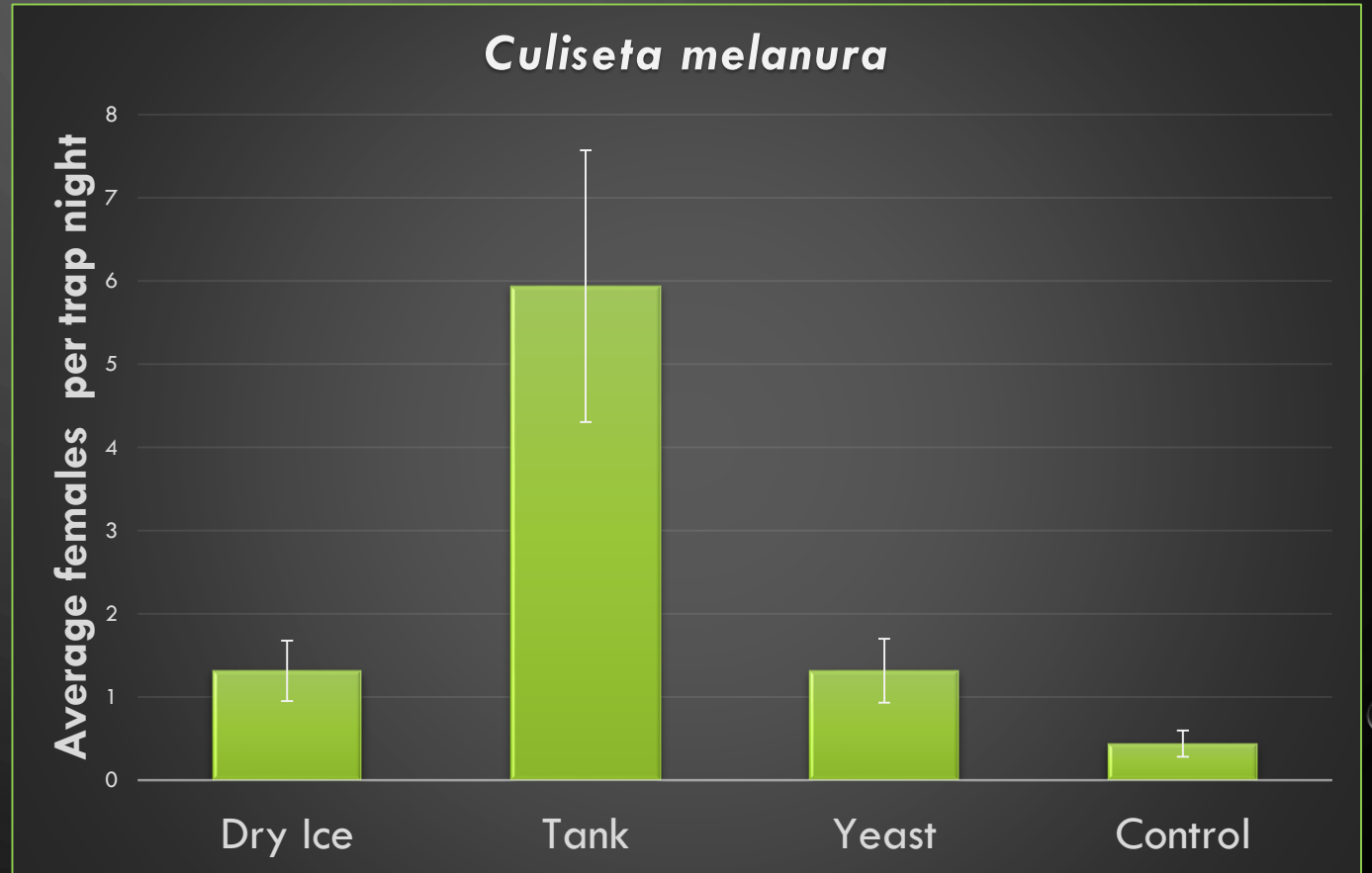
- Ice and Tank both significantly outperformed Yeast
- Yeast was not better than Control



2023 CO₂ SOURCE STUDY

ANOVA, post-hoc t-tests for
Culiseta melanura:

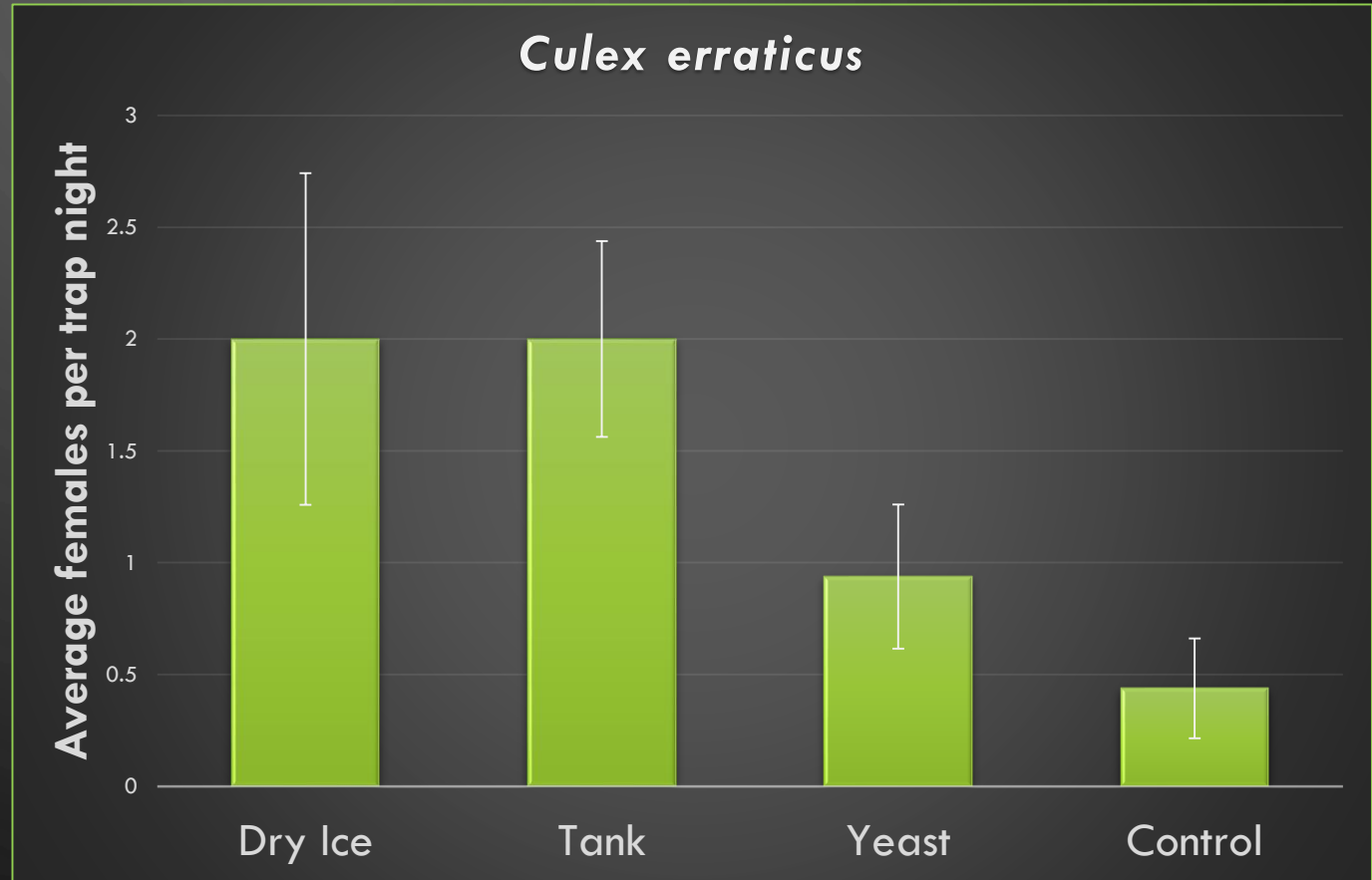
- Tank outperforms all
- No significant difference between Yeast and Dry Ice



2023 CO₂ SOURCE STUDY

ANOVA, post-hoc t-tests for *Culex erraticus*:

- Collections were quite low and variable
- No significant difference between Ice, Tank, Yeast
- Note: yeast not significantly different from control



2023 CO₂ SOURCE STUDY

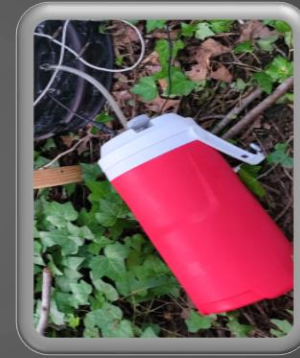
Materials Cost Comparison

- Using Suffolk inventory and routine surveillance as an example
- Roughly 50 CO₂ traps (BG or CDC) per week
- 1,373 traps set in 2023

TANK



DRY ICE



YEAST



Initial Expenses	40 tanks @\$114.50	\$4,580	20 "drink" coolers	@\$12	\$240	40 starter kits	@\$36.95	\$1,478
	20 regulators	@\$80.25	\$1,605	6 storage coolers	@\$54	\$324		
Startup Cost		*\$6,185			\$564			\$1,478

Annual Expenses	211 fills @\$18.71	\$3,947	*8,925lbs ice	@\$1.723	\$15,377	61 bags (25lb) sugar	@\$18.76	\$1,144
	parts + inspections	\$744				tap water		\$0
						138 yeast packs	@\$23	\$3,174
Annual Cost		\$4,691			\$15,377			*\$4,318

*Optional extras: flowmeter, scale, tank holders, gauges

*not accounting sublimation; lost ~ 10.5 lb/night from storage cooler

*save ~ \$1,000 1st year - each starter kit comes with 1 yeast pack

2023 CO₂ SOURCE STUDY

Manpower, Ergonomics, and Other Concerns

- Hazards
- Ease of use
- Maintenance
- Reliability

Tank

Dry Ice

Yeast

Flow/Output	✓ Consistent via regulator; no risk lasting 24 hr trapping period unless clog or leak occurs	✗ Inconsistent - based on amount of ice, cooler integrity, and environmental conditions	✗ Inconsistent - 2 hr lag to reach peak (75-125 ml/min) lasts ~14 hr
Carry weight	✗ Heavy, 18-26 lbs	✓ Light, 1-8 lbs	✓ Light, 5 lbs
Storage	✗ strong container bought or built to prevent falls	✗ large coolers/ventilation	✓ cabinet/shelf space
Transport	✗ container or structure to secure in truck bed	✓ minimal - ventilation or pickup truck bed	✓ minimal - no ventilation needs; sit upright
Maintenance	✗ parts (gauges, tubing, flow restrictors) and 5 yr inspections	✓ minimal - periodic cleaning of coolers, tube or cooler replacement over time	✗ daily cleaning mixing bag, potential parts replacement over time
Safety Hazards	✗ steel-toe protection; compressed gas safety	✗ Glove protection - Risk of skin burns (frostbite)	✓ None - just don't eat it
Waste	✓ Minimal with routine maintenance and kept off when not in use	✗ Substantial - constant sublimation	✓ None - mix when ready to set
Availability	? Warning of shortage - last 3 years	? Shortages/unavailable last 2-3 years	✓ Easy to obtain

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CONCLUSIONS & OTHER NOTES

- Dry Ice and Tank win overall in collection efficacy
- Yeast efficacy varied depending on species
 - Not attractive to *Cx. salinarius*
 - Better than nothing collecting *Ae. albopictus*
 - Equal to Dry Ice collecting *Cs. melanura*
 - Similar to Ice and Tank collecting *Cx. erraticus*

CONCLUSIONS & OTHER NOTES

- Dry Ice - most expensive, wasteful, unreliable but easy to use and relatively maintenance free
 - May be more economical to make in-house?
- Tank - much more affordable than ice in the long run but with some safety/storage needs and reliability concerns
- Yeast is cheapest, easy to obtain and use; no safety, storage, or waste concerns; however, inconsistent and lower CO₂ output

CONCLUSIONS & OTHER NOTES

- Experiment done during year of low populations and low diversity
- While Dry Ice collected the most, it was set using 6.5 lbs to last full 24 hr
 - More than normal 2-5 lbs
- If yeast sole source – would it collect more?
 - Increase amount of yeast and sugar?
- If cost or availability are issues – yeast could at least be a short-term solution

ACKNOWLEDGEMENTS

- Suffolk MC Staff

Jay Kiser

Jordan McCallister

Hadley Nation

Charles Abadam



The background is dark grey with several translucent, realistic-looking bubbles of various sizes scattered in the corners. The bubbles have highlights and shadows, giving them a 3D effect.

THANKS!

QUESTIONS?

COMMENTS?

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