



Mark-release-recapture experiment in Burkina Faso demonstrates reduced fitness and dispersal of genetically-modified sterile malaria mosquitoes

Franck A. YAO,

Institut de Recherche en Sciences de la Sante, Burkina Faso

VCWG Virtual 04 May 2022

Plan

1

Importance of the first GM release in Sub Saharan Africa

2

Results from the release

3

Broad insights into the fitness and behavior of GM males

4

Implications for future GM and gene drive work in Africa

5

Target Malaria next steps

Context

- Every year, malaria kills in Sub-Saharan Africa, much children under the age of five years
- Many countries, progress in malaria control has been threatened by the rapid spread of resistance to antimalarial drugs and insecticides
- Target Malaria, is a research consortium that aims to develop and share new genetic mosquito control tools for integrated malaria control strategies
- In this context, In July 2019, the consortium proceeded with the first release of a genetically modified (GM) strain of *Anopheles coluzzii* in Burkina Faso (BF)



**importance of the first GM release in
sub Saharan Africa**



Importance for researchers or scientifiques

- Estimate the daily survival rate of male mosquitoes of the sterile male strain compared to non-GM sibling males
- Understand dispersal of sterile male strain compared to non-GM sibling males within the area of the release site
- Assess the swarm participation of male strain and non-GM sibling males
- Familiarize with the technique
- Train and have competences on site

Importance for public or no scientifique

- Build trust with stakeholders, public
- Build an open dialogue with the public





Methods and Results from the release



Methods/Results

- **Period:** July 2019
- **Study design :** Marking – Release – Recapture experiment
- **Study site:** Village of Bana (23 km from Bobo Dioulasso, BF)



Marking phase



Release phase (14850)

➤ **DSM:** 6428

➤ **WT:** 8422

Recapture phase (527)

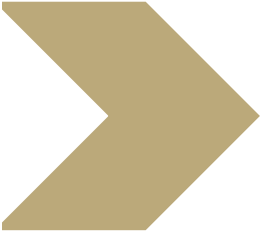


Numbers of marked males collected using swarm collection (SWN) and pesticide spray catches (PSC) during the 20 days of recapture of the MRR (Mark-Release-Recapture) study.

Stages	Recapture day	Swarms	PSC	TOTAL
Release day	1	71	-	71
Day 2	2	150	18	168
Day 3	3	74	16	90
Day 4	4	0*	14	14
Day 5	5	45	2	47
Day 6	6	39	5	44
Day 7	7	18	3	21
Day 8	8	23	0	23
Day 9	9	20	2	22
Day 10	10	15	0	15
Day 11	11	5	1	6
Day 12	12	2	1	3
Day 13	13	1	0	1
Day 14	14	1	0	1
Day 15	15	0	0	0
Day 16	16	0	0	0
Day 17	17	1	0	1
Day 18	18	0	0	0
Day 19	19	0	0	0
Day 20	20	-	0	
TOTAL		465	62	527



Results

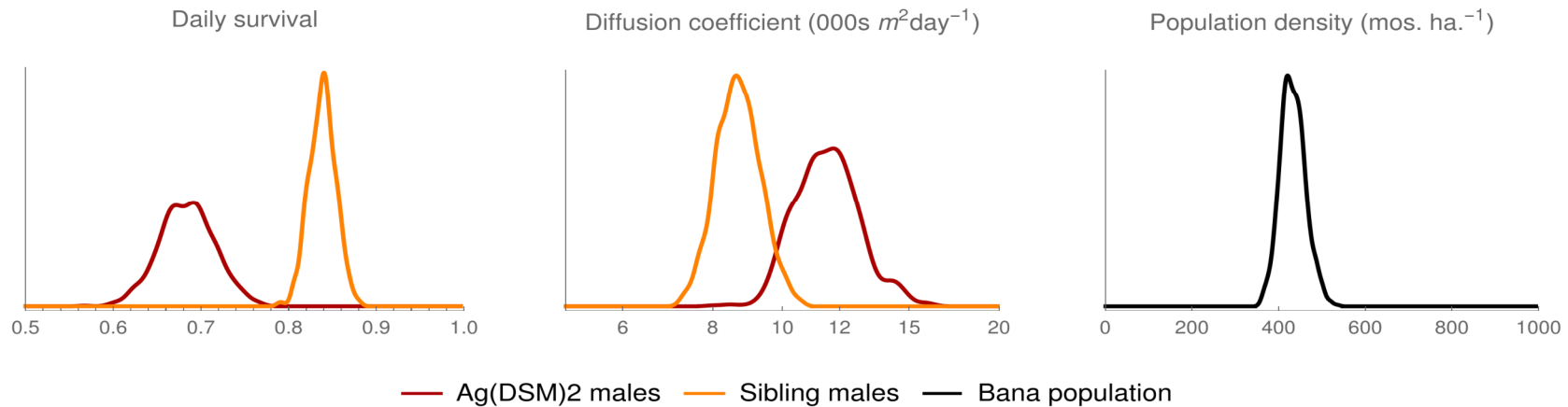
- 
- ❑ Majority of marked males (97.7%) were caught during the first ten (10) days after the release



- ❑ **Temporal distribution of recaptures and Euclidian dispersal distance:**

GM males were recaptured 50.8 - 497m (136.8m) and siblings 50.8 – 1,678m (171.1m) from the release point. As expected, the GM males were significantly less mobile than their wild type siblings (Mann Whitney: $Z = 4.592$; $df = 1$; $P < 0.0001$)

Bayesian estimates of survival, dispersal and population size



- ❖ The male population size at the time of release was estimated to be in the range 380 – 490 mosquitoes ha^{-1} which translates 28,000 - 37,000 male mosquitoes
- ❖ The swarms provide better estimates of population sizes compared to PSC data
- ❖ The released marked males of the strain Ac(DSM)2 have a daily survival rate ranging between 0.61 and 0.75 per day, which is lower than the non-transgenic mosquitoes, whose rate is between 0.81 and 0.87 per day



**broad insights into the fitness and
behavior of GM males**

fitness and behavior of GM males

These results provide information about the fitness and behavior of GM males released at the start of the rainy season:

- In general, GMs are less robust than their non-transgenic (Wild type) sibling because they have a lower mobility and daily survival rate than their wild type sibling; also they recognize and participate in swarming



Implications for future GM and gene drive work in Africa

- Is a first milestone towards future releases of more effective strains targeting the sibling species of the *A. gambiae* complex
- This first experience will allow us to obtain easily the different approvals for the future releases
- Training and recycling of staff and preparation of engagement activities for future work
- Good understanding of the regulatory environment and how to navigate through the system
- Very good team coordination to make sure that all the different sections of the project are well prepared and are working timely toward the final goal
- The Anti GMOs groups identified and still figuring out how to manage these groups
- Mistakes to avoid



Target Malaria next steps

End of the phase 1

Phase 2

Phase 3

No gene drive sterile male

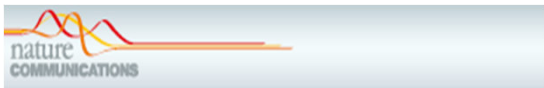
No gene drive male bias

Self sustaining gene drive mosquitoes &/or female fertility



cf. ARRÊTÉ N° 2021-287/MESRSI/SG/ANB du 26 juillet 2021

16 and 21 mars 2022: Importation of live eggs of no gene drive male bias mosquitoes



ARTICLE

<https://doi.org/10.1038/s41467-022-28494-0> OPEN

Mark-release-recapture experiment in Burkina Faso demonstrates reduced fitness and dispersal of genetically-modified sterile malaria mosquitoes

Franki Adams Yao¹, Abdou-Azize Millogo^{1,2}, Patric Stephane Epopa¹, Aou North¹, Florian Nautin⁴





Thank you

TargetMalaria.org

Acknowledgements

“Target Malaria receives core funding from the Bill & Melinda Gates Foundation and from Open Philanthropy”

BILL & MELINDA
GATES *foundation*

