SHORT TERM SCIENTIFIC MISSION (STSM)
SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA17108
STSM title: "Improvement of technologies serving the Sterile Insect Technique against *Aedes albopictus*"
STSM start and end date: 03/02/2021 to 04/04/2021
Grantee name: Marco Malfacini

PURPOSE OF THE STSM:
(max.200 words)

The Short-Term Scientific Mission (STSM), carried between the 3rd of February and the 4th of April, had the purpose of improving my knowledge on Sterile Insect Technique (SIT) technologies and the collaboration between Italy, France, and the International Atomic Energy. La Réunion Island is an overseas department of France located in the Indian Ocean.
The host institution was represented by CIRAD, at the Pole De Protection Des Plantes, in Saint Denis and Saint Pierre. CIRAD is a French research institution focused on Environmental and Agricultural research where, under the supervision of Dr. Jérémy Bouyer, I joined the REVOLINC team, a workgroup focused on applying the Boosted SIT against Aedes species.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS
(max.500 words)

The Boosted SIT project carried with the REVOLINC team has the purpose of strengthening the SIT technique by coating released sterile adult males with pyriproxyfen (PP). PP coated sterile males mating with wild females or even only touching them can contaminate the females and subsequently their larval habitats, leading to the improvement of SIT to control the target

population (Bouyer and Lefrançois, 2014; Douchet *et al.*, 2021). I had the opportunity to spend my time between CIrad's laboratories in Saint Denis and Saint Pierre.

Semi Field trial in Saint Denis:

The main activity I carried out in Saint Denis was focused on semi-field conditions to estimate the effects of Boosted SIT males compared to SIT males of *Aedes albopictus*; we performed the experiment obtaining 4 replicates.

The experiment was set up by arranging 8 cages (Fig.1,2, and Tab.1) to evaluate the competitiveness and PP effects. Also flight ability tests were performed to identify the quality of males (Culbert *et al.*, 2018, 2020).

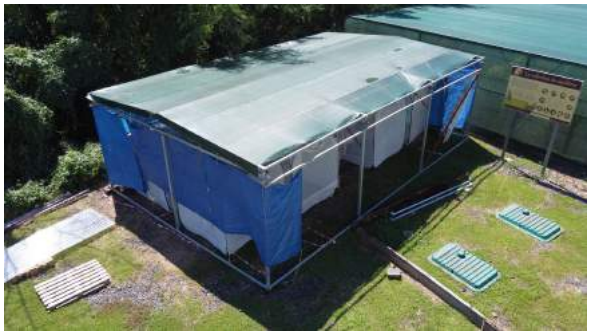

Fig.1 and 2 - Semi field cages, n.4 ♂BSIT and n4. ♂SIT cages were separated respectively. Images provided by DJI mavic mini drone.

1. ♂**BSIT** Treated Ratio 1:1:1	200 BSIT♂ : 200 Wild♂ : 200 Wild♀
2. ♂**BSIT** Treated Ratio 5:1:1	1000 BSIT♂ : 200 Wild♂ : 200 Wild♀
3. ♂**BSIT** Control	200 BSIT♂ : 200 Wild♀
4. ♂**BSIT** Control	200 BSIT♂
5. ♂**SIT** Ratio 1:1:1	200 SIT♂ : 200 Wild♂ : 200 Wild♀
6. ♂**SIT** Ratio 5:1:1	1000 SIT♂ : 200 Wild♂ : 200 Wild♀
7. ♂**SIT** Control	200 SIT♂ : 200 Wild♀
8. ♂**SIT** Control	200 SIT♂

Tab.1 - Semi field protocol cages, ♂BSIT, and ♂SIT cages position were changed and respectively managed by different operators at each replica.

Samples were provided by the French National Research Institute for Sustainable Development (IRD) at CYROI, Saint Denis. We also evaluated larvae, pupae, and adult survival to detect any possible effects caused by PP. Samples of water from each cage were collected for PP analysis.

Field trial in Saint Joseph, Saint Pierre:

The project started in Saint Pierre was aimed to evaluate the efficiency of Boosted SIT, using PP covered *Aedes aegypti* males into the field.

The pilot field trial has been conducted in two different areas of Saint Joseph, a municipality near to Cirad's laboratory in Saint Pierre (*Essais TIS Saint Joseph - REVOLINC*, no date). Males, under refrigerated conditions, were provided and weekly sent by Insect Pest Control Laboratory, Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture, Vienna, Austria. Males were then treated with PP (Fig.3,4) and released into the field.

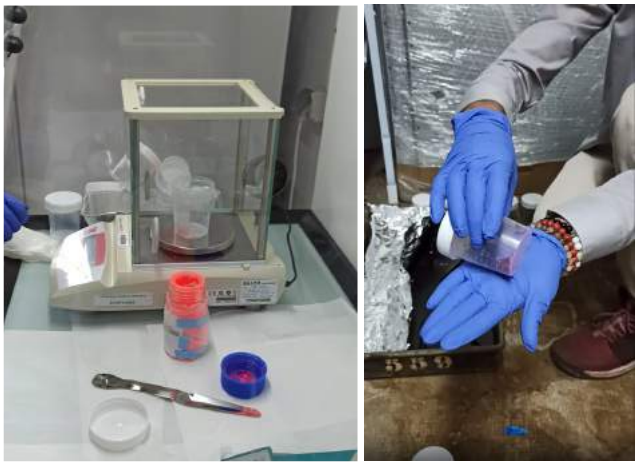

Fig. 3 and 4 - Pyriproxyfen and fluorescent powder treating procedures.

In both areas, a monitoring network using BG-sentinel II traps and ovitraps has been performed to estimate the wild population density of *Ae. albopictus*, *Ae.aegypti,* and to realize a mark release recapture trial (European Centre for Disease Prevention and Control., 2012).

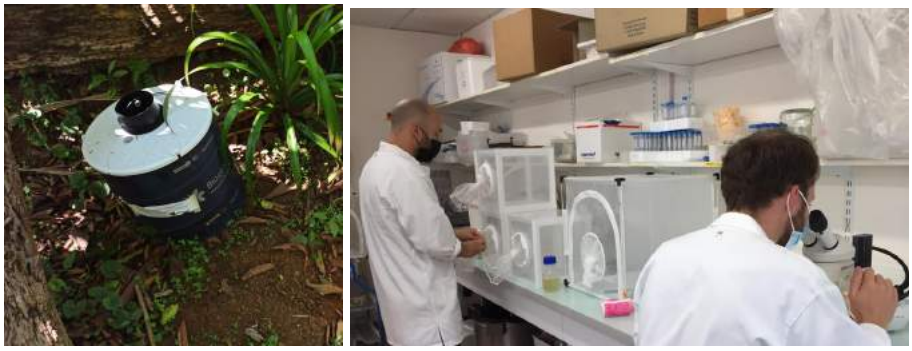

Fig. 5 and 6 - Bg sentinel II (left), identification and sample managing (right).

DESCRIPTION OF THE MAIN RESULTS OBTAINED

During my collaboration with the REVOLINC group, I was able to learn and improve my knowledge on SIT, in particular referring to the Boosted SIT, where it would be a strong candidate for mosquito control, especially in areas where the breeding sites are represented by small basins in private gardens or in places not well accessible with standard methods. In this case, the release of PP sterile males will be evaluated using drone release.
In Saint Denis we carried a semi-field experiment on *Ae. albopictus* to evaluate the efficiency and competitiveness of Boosted SIT compared to SIT males; an article will be published under responsibility and in collaboration with the semi-field responsible Dr. Marlene Dupraz and the head team Dr. Jérémy Bouyer.
During the activity, I was able to improve my expertise on competitiveness evaluation, fluorescent marking, PP treatment, and quality control procedures. In this case, quality control procedures included were sex ratio, hatching rate, mortality at all stages, and flight ability tests (Balestrino *et al.*, 2014; Culbert *et al.*, 2020).

A field trial was also performed to test the efficiency of Boosted SIT on *Ae. aegypti*, and a Pilote releasing program was set up in Saint Joseph.
I was involved in the monitoring surveillance network specifically activated and performed for *Ae. aegypti* detection. In particular, we used Bg sentinels II traps and ovitraps, specifically adopted, and under publication, by REVOLINC to better estimate the *Ae. aegypt*i density population.
At Saint Pierre laboratories, I improved my identification skills on *Culex quinquefasciatus*, *Ae. albopictus* and *Ae. aegypti* at different stages. Furthermore, I was involved also in the quality control assessment of released *Ae. aegypti* males, evaluating shipment impact on males fitness. The males shipment was carried using two different types of refrigeration protocols, respectively developed by International Atomic Energy Agency (IAEA) and Centro Agricoltura Ambiente (CAA).
We displaced shipped males into cages, providing them with sugar solution, letting them recover for one night. Indeed, we looked up at mortality, body deterioration as the number of legs and wings but also at flight ability. After the control routine and the PP treatment, we released them into the field.
Unfortunately, the flight length was too long, due to shipping delayings, and this highly affected the mosquitoes' survival. For these reasons, while I was there, we chose to conduct the release, for the first period, personally.
During the monitoring, I also contributed to develop and implement a specific protocol for PP effects evaluation on larvae. From each ovitraps, as well as for the ovitrap strips, we collected the water. This was in order to hatch and rear larvae in the same water from each oviposition site, this allowed us to expose the present larvae at the same quantity of PP present into the field. The mortality was measured consecutively over the time.

The data being the host institution's own research activities, will be publicly exposed at the end of the experimentation activity which is still ongoing.

FUTURE COLLABORATIONS (if applicable)

Thanks to the Aim-Cost action I was able to join the revolink group for a Short Term Scientific Mission being me also very keen to establish transboundary networks with different European partners.
I enjoyed the collaboration of several partners including CIRAD, IAEA, IRD and the Italian institutions the University of Bologna and Centro Agricoltura Ambiente.
I found my experience abroad very interesting not only for the activities carried out but also for the possibility to get to know different cultures and working environments. Finally, I saw myself growing both as a person and as a professional scientist, and for this reason, I kindly thank the Aim-Cost and the REVOLINC team headed by Dr. Jérémy Bouyer for this opportunity.
I am strongly confident that our collaboration has implemented the friendship between various Italian and French institutes, and I am fully confident that this can lead to the development of new joint action and synergies at European level.

References

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