

**Creation and development of a mass-rearing facility for sterile insect techniques to control mosquitoes at the Anastasia Mosquito Control District**

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For more than 60 years, sterile insect technique (SIT) has been developed and successfully implemented as a sustainable area-wide integrated pest management program against several pest and vector species of medical and veterinary importance, including screwworms, tsetse flies, and mosquitoes (Benedict 2022, Morreale et al. 2022). SIT is a species-specific and environmental-friendly technology for the control of mosquitoes with positive public acceptance worldwide (Benedict 2021, Sypes et al. 2021).

In recent years, mosquito-borne diseases have emerged, resurged, and caused major global epidemics and public health problems, such as the outbreaks of malaria in 2023, Chikungunya in 2014, Zika in 2016, and dengue fever in Florida. Due to a lack of vaccines and increased insecticide resistance, control of mosquito-borne diseases has been facing major problems and challenges. *Aedes aegypti* Linnaeus is a container-inhabiting mosquito and a major vector of yellow fever, dengue, Zika, and Chikungunya. *Aedes aegypti* was a predominant species in St. Augustine, Florida before the 1990s and this species gradually disappeared after the invasion of *Aedes albopictus* Skuse in the 1980s. The last recorded collection of *Ae. aegypti* in St. Augustine was 1991 (Betts 1994). After *Ae. aegypti* disappeared for 25 years, it reappeared in downtown St. Augustine in early 2016, then continued to establish itself throughout St. Johns County (Dixon et al, 2020). When Anastasia Mosquito Control District (AMCD, <https://www.amcdsjc.org>) found the resurgence of this species, the district quickly collaborated and worked with the Department of Health (DOH) of St. Johns County to launch an eradication program and conducted the inspection and education about prevention and control through a door-to-door, street by street weekly campaign lasting for several months. However, AMCD's eradication efforts for *Ae. aegypti* failed (Xue et al. 2020). Therefore, AMCD has consulted and collaborated with federal agencies, universities, and industry partners to identify new control tools/methods. Luckily, scientists from the University of Florida (UF, Gainesville, FL), USDA/Center for Medical, Agriculture, and Veterinary Entomology (CMAVE, Gainesville, FL), and MosquitoMate (Lexington, Kentucky) assisted and collaborated with AMCD to control this species of mosquitoes. In 2016, the AMCD Board of Commissioners approved the proposal and collaboration with D. Hahn at UF and K. Linthicum at USDA/CMAVE to adopt SIT for control of *Ae. aegypti* in St. Augustine. The City of St. Augustine was one of the testing sites for SIT evaluation grants funded by the Florida Department of Agriculture and Consumer Service (FDACS) to D. Hahn and K. Linthicum from 2017-2018, 2018-2019, and 2020-2021. Later, the Centers for Disease Control and Prevention (CDC) and Florida DOH funded D. Hahn, K. Linthicum, and R.D. Xue for the operational control of *Ae. aegypti* by SIT in St. Augustine for 2 years (2020-2022). Also, in 2017, AMCD's Board of Commissioners approved the proposal to collaborate with MosquitoMate to release *Wolbachia*-infected male mosquitoes for evaluation in St. Augustine, Florida. MosquitoMate and AMCD did the field testing in 2018 and 2019. Both methods showed a 70–90 % population reduction after the release of SIT male mosquitoes and *Wolbachia*-infected male mosquitoes (Sypes et al. 2021, Chen et al 2022). During the mass field trials using the two new methods, more than 80% of St. Augustine residents in the evaluation area accepted the new methods after surveys were conducted (Sypes et al. 2021).

Since the completion of the successful SIT projects, and the benefits gained from the collaborations with federal agencies, universities, and industry (Xue et al. 2016, Xue & Qualls 2022), AMCD started to campaign to build our SIT mass-rearing facility. One of the biggest issues faced by industry-producing SIT mosquitoes is the shipping of treated mosquitoes from other cities to their release locations. Having an SIT facility in Northeast Florida could allow for easier shipping to areas experiencing *Ae. aegypti* populations along the East Coast. On 14 May 2020, the AMCD Board of Commissioners approved the SIT funding proposal and requested the Florida State legislature to match AMCD's funding for the development of the SIT program. The proposal included letters from AMCD Board's Chairperson Jeanne Moeller and Executive Director R.D. Xue to the State Senators and Representatives, and the St. Johns County's Administrator. The proposal also included flyers about SIT and *Wolbachia*-infected mosquitoes (MosquitoMate's ZAP mosquitoes), SIT trial results in St. Augustine reported by D. Hahn from 2017–2019, evaluation reports from S. Dobson from MosquitoMate for 2018–2019. A draft building design, floor plan, and budget were also presented. Support letters were also included from R. Pereira, Head of the Insect Pest Control Section, Joint Food Agriculture Organization /International Atomic Energy Agency (FAO/IAEA), Division of Nuclear Techniques in Food and Agriculture, FAO/United Nations, J. Conlon, Technical Advisor of the American Mosquito Control Association, USDA/CMAVE's Center Director K. Linthicum, UF/Dept. of Entomology and Nematology's D. Hahn, MosquitoMate's S. Dobson, former SIT pioneer D. Dame, and six county-based mosquito control organizations in northeast Florida. The six supportive representatives from local mosquito control programs were B. Allen, Entomologist from Jacksonville MCD, P. Jiang, Director from the City of Gainesville MCD, B. Jackson, Director from Bradford County Public Works, M. Wasdin, Director from Putnam County Sanitation Department, S. Barlett, Director from Volusia County MCD, and M. Positano, Director from East Flagler MCD.

On 17 June 2021, the AMCD Board approved the release of the request for proposal (RFP) for the SIT mass-rearing facility. On 12 August 2021, the Board accepted and approved the RFP submitted by Harrell Construction for the SIT building design (Fig. 1) and building the SIT building at a contract cost of \$2,099,361. On 6 June 2022, the Board approved the final contract with Harrell Construction to build the SIT mass-rearing facility. The SIT building was planned to be in operation by the end of March 2023, but due to COVID-19 supply chain issues construction has stalled with a completion date by the middle of 2024 (Fig. 1).



Fig. 1. SIT building floor plan (left bottom) and the building (right), St. Augustine, Florida, USA.

The agreed building layout divides the 6,000 s.f. building into two large areas: the 1st area includes 4 offices, a small break/conference room, and a new molecular biology laboratory; the 2nd area

includes 4 mass rearing rooms separated by a center separation room. Also included in this area is a radiation treatment room with a Rad Source irradiator (Atlanta, GA) (Fig. 2). The four mass-rearing rooms can serve as larval rearing (Fig. 3), pupal sex-separated room (Fig. 4), and adult-holding rooms depending on setup. In addition, a washing/cleaning room and a storage room are included in the SIT space. AMCD plans to run in full operation starting in the middle of 2024. In the beginning, AMCD will focus on mass rearing and releasing radiated *Ae. aegypti* at 250,000–1 million males/week and mass-rearing *Aedes albopictus* infected with *Wolbachia* at 250–500,000 males/week. In the meantime, we will collaborate with universities and industry at national and international levels to explore/study/develop SIT for control of the WNV vector *Culex* mosquitoes, EEE vector *Culiseta* mosquitoes, malaria-vector *Anopheles* mosquitoes, and salt marsh mosquitoes. After competencies are gained, AMCD plans to increase mass production and provide SIT-treated male mosquitoes to other county programs in northeast Florida per request.



Fig. 2. Radiation machine for irradiating mosquitoes at AMCD's mass rearing facility, St. Augustine, Florida.

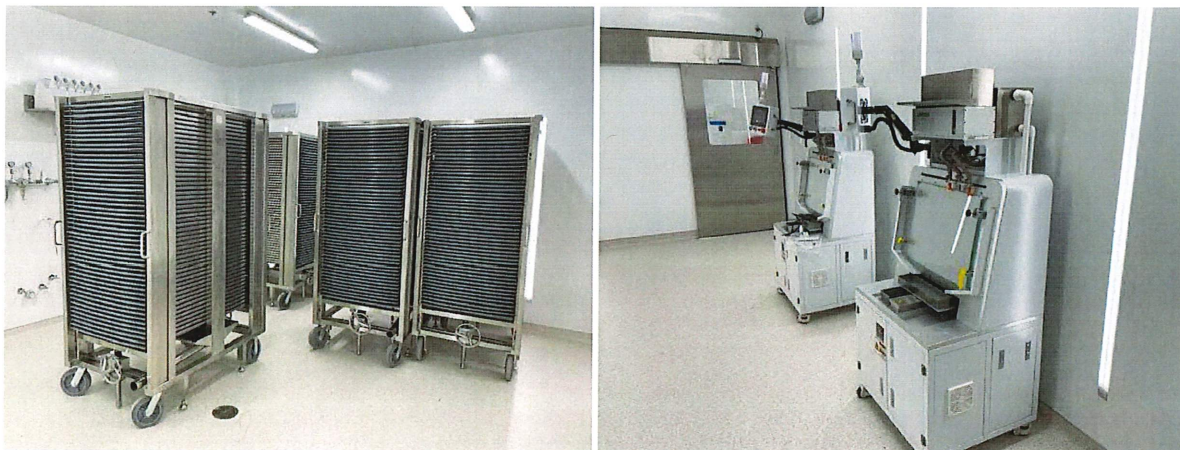


Fig. 3. Larval mass rearing equipment (left) and pupal sex separator (right) in the SIT building.

AMCD has used its experience in the creation and development of an SIT facility for the control of vector mosquitoes and will adopt this technique as one component of the integrated mosquito management program. Although the cost and sustainability of the operation of SIT programs have been a concern (Benedict 2021), the species-specific and environment-friendly method will play an important role in the successful control of mosquitoes and mosquito-borne diseases. This technique and development of the mass rearing facility will benefit the citizens of St. Johns County and the people of Northeast Florida. This is part of the stated AMCD's mission and goals which would like to be recognized as one of the leaders in the field of mosquito control, applied research, and education in the state and nation.

On 24 August 2023, US Congressman John Rutherford and his office staff took a tour of AMCD's Disease Vector Education and SIT Facility (Fig. 6). AMCD held a dedication of SIT on 18 January 2024 (Figs 4, 5), and a grand opening ceremony for the Disease Vector Education Center and SIT mass rearing facility on 26 March 2024 (Fig. 7), before the 19th Annual Arbovirus Surveillance and Mosquito Control Workshop.

Thanks, and appreciation for the support from AMCD's former and current Board of Commissioners, staff, many peers/colleagues, Harrell Construction Company, CDC/DVBD, University of Florida, USDA/CMAVE, MosquitoMate, FDACS, FDOH, and 6 regional mosquito control programs from the northeast and north central Florida, and the citizens of St. Johns County, Florida.



**Fig. 4.** Commissioner/Vice Chairperson Mrs. Martha Gleason spoke at the dedication ceremony of the SIT facility, on 18 January 2024.



**Fig. 5** (top row). Commissioner Mrs. Catherine Brandhorst (right) and two former Commissioners Mrs. Jeanne Moeller (middle), and Mr. Donald Girvan (left) on the SIT building dedication ceremony, 18 January 2024, with plaque to left. **Fig. 6** (bottom left). Congressman John Rutherford and his staff visiting AMCD's SIT mass-rearing facility on 24 August 2023. From right: Whitney Qualls, the office staff of the congressman, Trish Becker (commissioner), John Rutherford (congressman), field director of Congressman, and Steve Peper. **Fig. 7.** Dr. Rui-De Xue (right) & Mr. Richard Weaver (left) at the grand opening ceremony of the Disease Vector Education Center and mass-rearing facility for SIT for control of mosquitoes, March 26, 2024.

## References

- Benedict, M.Q. 2021. Sterile insect techniques: Lessons from the past. *Journal of Medical Entomology* 58:1974-1979.
- Betts, R.R. 1994. *Aedes albopictus* and *Aedes aegypti* species domination in St. Johns County. *Journal of the Florida Mosquito Control Association* 65:17-19.
- Chen, C., Aldridge, R.L., Gibson, S., Kline, J., Aryaprema, V., Qualls, W., Xue, R.D., Boardman, L., Linthicum, K.J. & Hahn, D.A. 2022. Developing the radiation-based sterile insect techniques (SIT) for controlling *Aedes aegypti*: identification of a sterilizing dose. *Pest Management Science* 79:1175-1183.
- Dixon, D., Autry, D., Martin, J. & Xue, R.D. 2020. Surveillance of *Aedes aegypti* after a resurgence in downtown St. Augustine, Northeastern Florida, *Journal of the Florida Mosquito Control Association* 67:15-22.
- Morreale, R., Hoel, D., Lloyd, A. & Jackson, E. 2022. Developing a sterile insect technique program for control of the yellow fever mosquito *Aedes aegypti* in Lee County, Florida. *Wing Beats* 31:37-46.
- Sypes, O., Bangonan, L., Rodriguez, D., Qualls, W.A., Xue, R.D. & Aryaprema, A.S. 2021. Mosquitoes shooting blanks. *Wing Beats* 32:5-11.
- Xue, R.D., Bibbs, C.S., Dixon, D. & Autry, D. 2020. A new laboratory colonization of *Aedes aegypti* after reemergence and unsuccessful eradication in St. Augustine, Florida. *Journal of the Florida Mosquito Control Association* 67:73-75.
- Xue, R.D., Fulcher, A., Scott, J.M., Qualls, W.A. & Smith, M.L. 2016. Benefits and accomplishments gained from outside collaborations at Anastasia Mosquito Control District. *Wing Beats* 27:29-35.
- Xue, R.D., Qualls, W.A. 2022. Innovation and technology application in Anastasia Mosquito Control District, St. Augustine, Florida. *Proceedings and Papers of the Mosquito and Vector Control Association of California* 90: 52–56.

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