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A boosted-SIT field trial against *Aedes albopictus* (Diptera: Culicidae) in Greece

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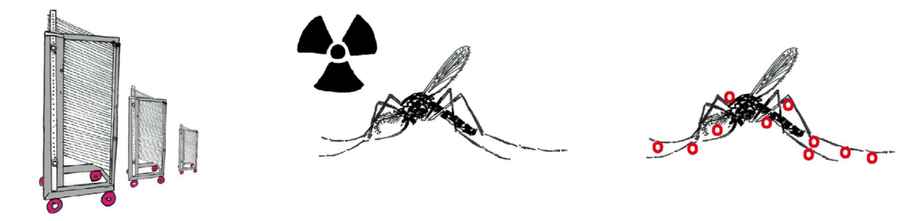
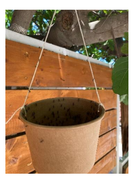
Introduction

Aedes albopictus, commonly known as the Asian tiger mosquito, is an invasive container-breeding mosquito species of great medical importance widely distributed in Greece. The boosted Sterile Insect Technique (SIT) applied by releasing irradiated males coated with a larvicide (pyriproxyfen-PPF) has been proposed as an alternative management method for the *Aedes* container breeding mosquitoes (Bouyer & Lefrançois, 2014). Herein, we report the results from a phase-II pilot scale boosted-SIT field trial that was conducted for the first time in Greece from May to October 2023 aiming to suppress *Ae. albopictus* population (Giatropoulos *et al.* 2025).

(1) Mass rearing of *Ae. albopictus* (2) Irradiation of *Ae. albopictus* males (3) PPF coating of *Ae. albopictus* SIT males



(4) Release of PPF-coated SIT males



(5) Mating of PPF-coated SIT males with wild females

(6) Contamination of larval habitats with PPF by wild females

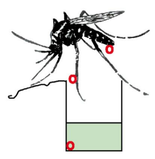


Figure 1. Presentation of the "boosted Sterile Insect Technique" concept

Materials - Methods

- Treated site: a 15-ha site in Attica, Greece.
- Untreated control site: a 5-ha site in Attica, Greece.
- Release rate: 3,466 ± 193 PPF-coated sterile *Ae. albopictus* males/ha/week
- Scheme of releases: 6 weekly releases at the beginning (12 May to 16 June) and at the peak (1 September to 6 October) of mosquito activity
  2 MRR sessions were included on 14- and 21- July.

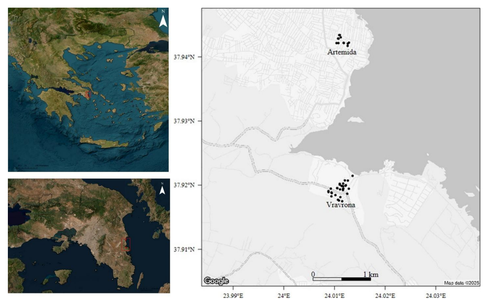


Figure 2. Treated (Vravrona) and control (Artemida) sites for the boosted-SIT trial. Sampling stations (ovitraps + HLC) located at the black points.

- Efficacy evaluation: Ovitraps (20 in the treated site Vs 7 in the control site)
  Human Landing Catches (10 in the treated site Vs 5 in the control site)
- The relative density Θ_i for exposure period i was the density of eggs or adults collected in the treated site (Y_i), divided by the expected density in the control site (E_i) during the same period: $\Theta_i = Y_i/E_i$. Data were grouped by time periods (approx. 1 month each) as shown in Figure 3.

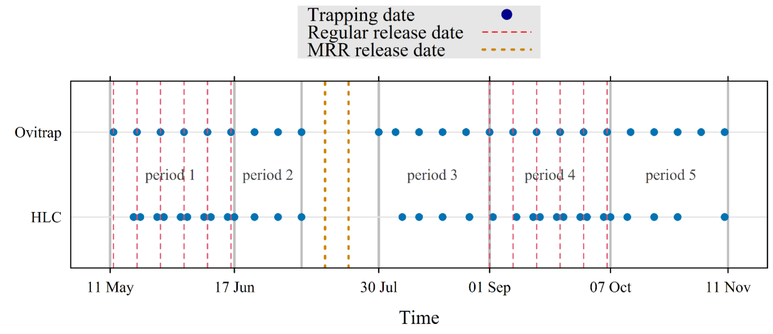


Figure 3: Time coverage of entomological collections and releases of boosted sterile males

- Egg hatching rate was estimated with a Bayesian mixed-effect binomial logistic regression of the observed ratio of the number of hatching eggs to the total number of eggs corrected with the number of damaged eggs. This ratio was used to estimate the competitiveness of sterile males, i.e., their capacity to mate with fertile females in the presence of wild males

$$C_i = \frac{P_{h,control} - P_{h,i}}{P_{h,i}} \times \frac{1}{R}$$ with R the estimated ratio of sterile to wild males.

- A mixed-effect Poisson model of mosquito density was used to assess the efficacy of boosted SIT on *Ae. albopictus* density, and its spatial variations.
- The assessment of persistence of boosted-SIT was based on the difference in relative density between periods 1 and 2, as well as between periods 4 and 5. To test the assumption of no persistence (Ho), for each set $\delta_{x,y}$, we computed its mean and 95% credible interval, and p=$P(\delta_{x,y}<0)$. If p≥0.95, Ho was accepted.

Results

Figure 4. Observed (a), and relative (b) density of *Ae. albopictus* eggs and adults.

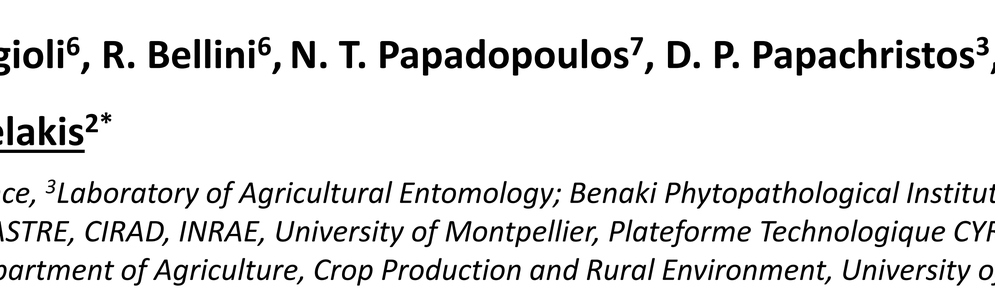


Figure 5. Efficacy of boosted SIT in suppressing the *Ae. albopictus* population of eggs in the treated site.

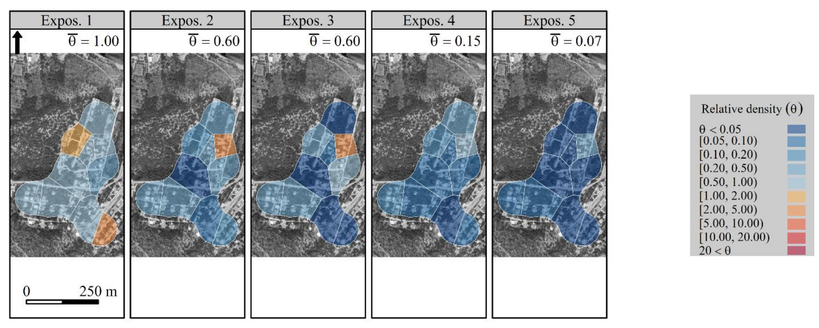


Figure 6. Efficacy of boosted SIT in suppressing the *Ae. albopictus* population of adults in the treated site.

Table 1. Key-findings during the boosted SIT trial against *Ae. albopictus* in Vravrona, Attica, Greece.

Exposure Period (Dates)	Relative density of eggs	Relative density of adults	Egg hatching rate	Boosted-SIT male competitiveness index	Boosted sterile-to-wild male ratio
1 (12/05-17/06)	0.92	1.00	0.56	0.18	2.76
2 (18/06-14/07)	1.13	0.60	0.73	0.13	1.98
3 (30/07-01/09)	2.24	0.60	0.89	Inf	0.00
4 (02/09-07/10)	1.65	0.15	0.56	NA	15.16
5 (08/10-10/11)	1.12	0.07	0.57	0.46	1.03

Persistence of boosted SIT on relative density of eggs:
- Between periods 1 and 2: No persistence effect [$P(\delta_{(1-2)}<0)>0.999$]
- Between periods 4 and 5: Persistence effect [$P(\delta_{(4-5)}<0)<0.001$]

Persistence of boosted SIT on relative density of adults:
- Between periods 1 and 2: Persistence effect [$P(\delta_{(1-2)}<0)<0.001$]
- Between periods 4 and 5: Persistence effect [$P(\delta_{(4-5)}<0)<0.001$]

Discussion - Conclusion

- ➢ No overall effect on egg densities was noted in the treated site, while a significant decrease compared to a control site was recorded in specific locations.
- ➢ The egg hatching rate in the treated site was lower than the control site during the release cycles and one month following the second release cycle.
- ➢ During the second release cycle and the following month, an overall suppression of the adult population was achieved, and high boosted sterile-to-wild male ratio and competitiveness index of boosted-SIT males were recorded, respectively.
- ➢ The suppression of both adult and egg populations was more pronounced a month after the conclusion of releases, indicating a residual activity of boosted-SIT.
- ❖ In conclusion, our findings demonstrate the potential of boosted-SIT against *Ae. albopictus* particularly in suppressing adult population.

References

Bouyer, J. & Lefrançois, T. 2014. Boosting the sterile insect technique to control mosquitoes. *Trends Parasitol.* 30, 271–273; https://doi.org/10.1016/j.pt.2014.04.002.

Giatropoulos A., et al. 2025. Suppression of *Aedes albopictus* (Diptera: Culicidae) populations using the boosted sterile insect technique in Greece, 12 August 2025, PREPRINT (Version 1) available at Research Square [https://doi.org/10.21203/rs.3.rs-7065292/v1].