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Evaluation of Machine-Based Sources for Sterile Insect Technique: A Landscape Study

Global Material Security

ORS Office of Radiological Security
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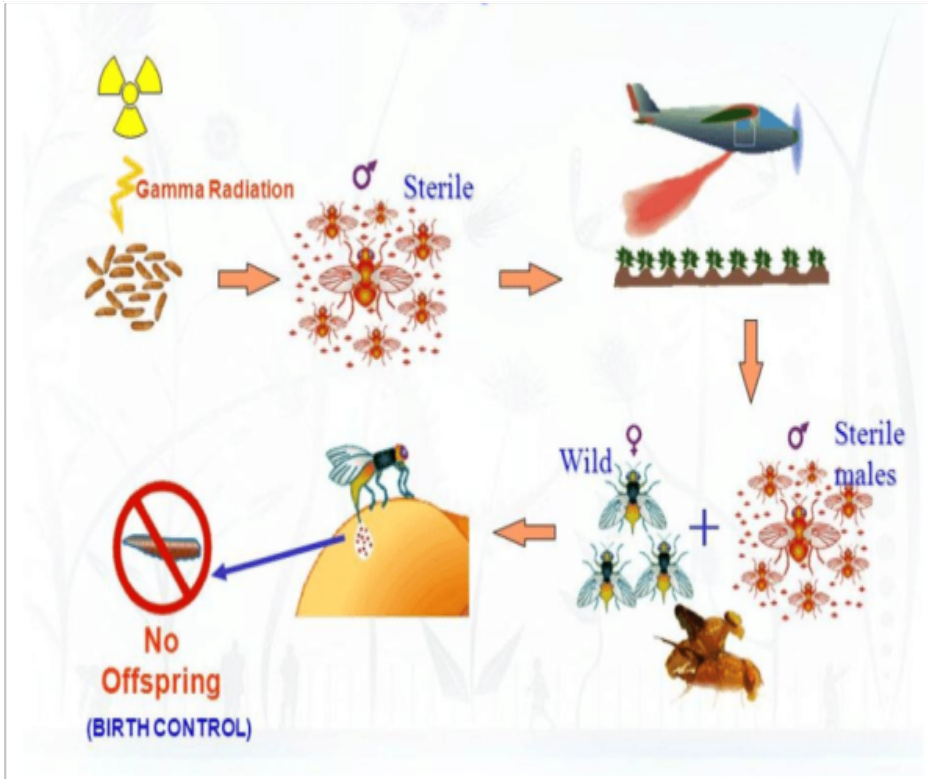
The study objective is to detail the current landscape of SIT

- The research objectives for this study were to develop an understanding of:
  - **The existing SIT facilities**
    - **Their target pests and technology types**
  - **Alternative technologies such as x-ray or e-beam**
  - **Vulnerabilities to current sources**
  - **The unmet demand or opportunity for SIT in concentrated pest locations**
  - **Technology and cost comparison**
- There has been growth in both SIT and the technologies it employs so it is necessary to gain an understanding of the current landscape
- This study was performed to enable decision makers to evaluate the potential impact of alternative sterilizing techniques



https://www.researchgate.net/figure/Sterile-Insect-Technique_fig4_329179423

Data collection has been performed to fill in lit review gaps

- The DIR-SIT and various databases to determine
  - Facility locations
  - Insect types at each facility
  - Technology used for each insect type irradiation
- In interest of preliminarily determining the unmet market demand and opportunity for SIT, map data of each insect type of concern was used and compared to facility location
  - A caveat here is that facilities "sphere of influence" can be larger than just its surrounding area
    - Though the distance of transportation for insects is limited by lifespan and irradiation
- Interviews were conducted with various government agencies, and facilities to supplement information that could not be found during the lit review and data collection and specifically to determine:
  - Which existing facilities supply sterilized insects to remote problem areas, or where there are gaps
  - Where there might be interest in new facilities, including the installation or replacement of isotopic sources for Alt-tech

Initial Data Collection

Insect Name	Bug Type	Sterilization Motivation	Number of Facilities
Aedes Aegypti (Yellow Fever Mosquito)	Mosquito	Disease Vector	6
Aedes albopictus (Stegomyia albopicta) Asian tiger mosquito	Mosquito	Disease Vector	3
Amyelois Transitella (monotypic snout moth)	Moth	Food Pest	1
Anastrepha Ludens (Mexican FruitFly)	Fly	Food Pest	3
Anastrepha obliqua	Fly	Food Pest	1
Anastrepha fraterculus (South American Fruit Fly)	Fly	Food Pest	1
…	…	…	…

Sterilization Motivation	Facilities
Disease Vector	26
Food Pest	52
Parasite	1
Pest Control	8
…	…

Country	Name	Operated By	Address	Link	Machineas listed by IAEA	Machines on website	Source for Machine	Method	Activity
Argentina	Bioplanta Multiproposito	ISCAMEN	Ruta Prov. Nº 71, KM. 11, Localidad "El Ortizano", Departamento "Santa Rosa", Mendoza, Argentina	http://tinyurl.com/d77uao2	IMCO 20			Isotopic Co-60	
Argentina	Bioplanta San Juan	PROCEM San Juan	Avenida Benavidez 8000 Oeste - Marquesado - San Juan - CP 5407	https://www.youtube.com/watch?v=cTB1BmZ18Z4	Gammacell 220		IAEA	Isotopic Co-60	
Australia	Queensland Fruit Fly Production Facility	New South Wales Agriculture	New South Wales Agriculture, Elizabeth Macarthur Agricultural Institute, Camden, PMB 8 NSW 2570.	http://www.dpi.nsw.gov.au/agriculture/pests-weeds/insects/qff	N/A			Isotopic Co-60	
Australia	National SITplus Facility	National SITplus Facility	1-3 Prosser Street, Port Augusta SA 5700	http://www.pir.sa.gov.au/	RS 24003			X-ray	
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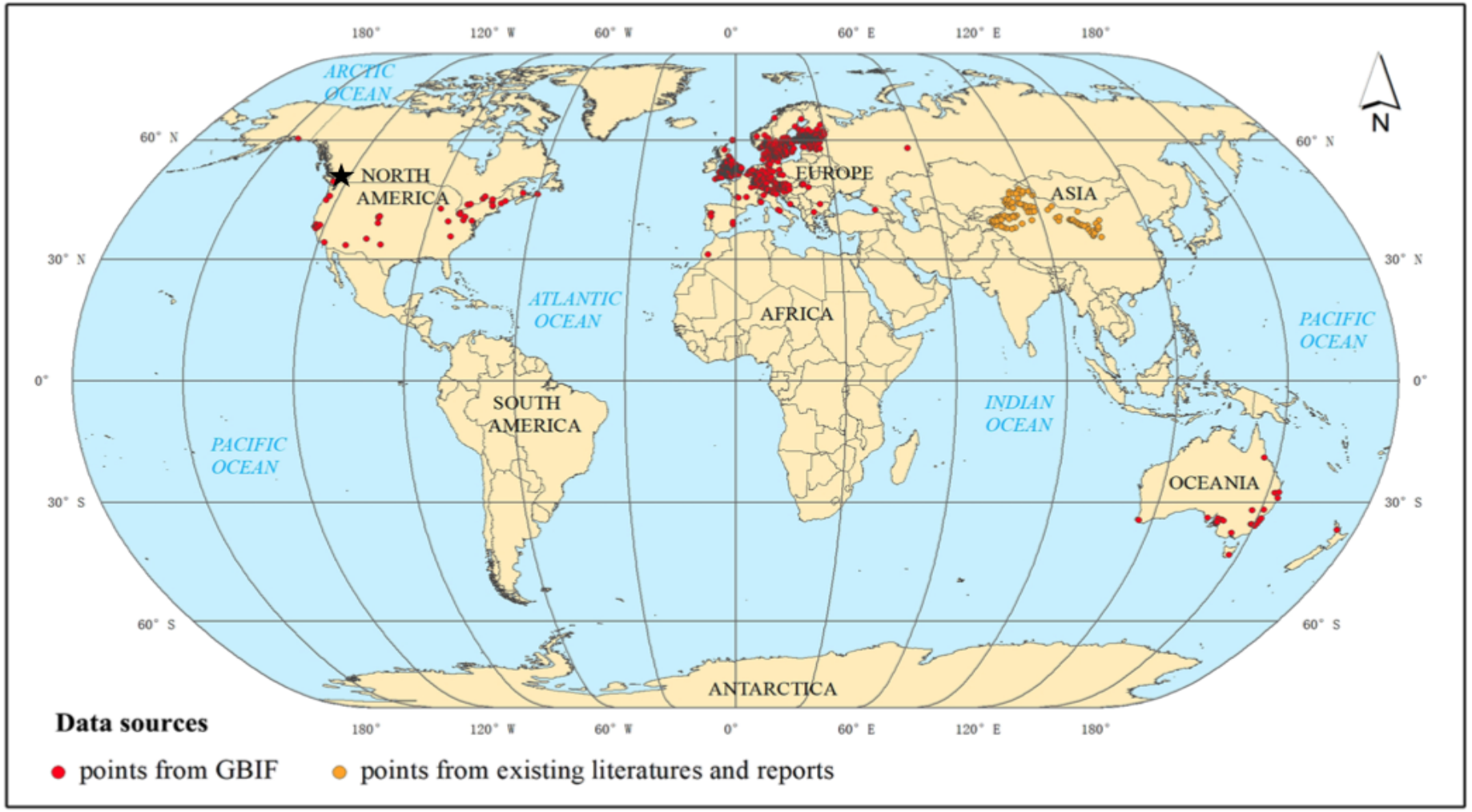
Coddling moth populations and the single coddling moth irradiation facility



This map illustrates an example of the data that the team has gathered to preliminarily determine where unmet demand and opportunity might lie for SIT. Further investigation is needed.

Cost and technological comparisons are being performed

- Cost information for various gamma, x-ray, and e-beam irradiators was gathered
  - A cost comparison between the various technologies and their processes required for maintenance, security, etc. is being performed
    - Some of this data is difficult to determine or unable to be found
- Comparative studies were reviewed on the pros and cons of each technology type to determine advantages and disadvantages of each
  - Gamma technology is still the primary method of SIT due to its reliability, dose uniformity, penetration and fair throughput
  - X-ray appears to be the best alternative to gamma, but must be employed sparingly due to its low throughput which is caused by a number of factors such as high DUR and low penetration
    - Also suffers from energy usage and cost
  - E-beam shows promise in high throughput but is very costly due to a lack of irradiator options
    - New prototypes are being designed and tested that could prove effective in the future

Cost Comparison

Cost Category	X-ray	eBeam	Gamma	Source
CAPITAL COSTS				
Irradiator/Accelerator Cost	$ 260k	$ 2400k	$ 693k	Foss Therapy interview, Centre for Radiation Research and Technology, CIRP Program
Water Cooling/ Ventilation	-	$ 520k	-	Centre for Radiation Research and Technology
Security (Initial)	-	-	$ 120k	
Construction Materials	-	$ <1k	-	Centre for Radiation Research and Technology
Electrical Equipment	-	$ 20k	-	https://everythingwhat.com/how-much-does-it-cost-to-have-3-phase-power-installed Centre for Radiation Research and Technology https://www.americanrotary.com/blog/benefits-rotary-phase-converter-compared-utility-three-phase-three-phase-generator/
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