

Arthropod Containment In Insectaries

Pr. Madama BOUARE Faculty of Science & Technique University of Bamako, Mali
Coordinator GMV Course in Africa

Document consulted : Vector-Borne and zoonotic diseases, volume 3, number 2,2003

Mary Ann Liebert, Inc.

[Http://www.astmh.org/subgroup/acme.asp](http://www.astmh.org/subgroup/acme.asp)

Introduction

- While GMOs have potential to improve well-being, their potential side effects on the environment and human health have been of increasing concern.
- The controversies have led to calls for the elaboration of “**Bio safety**” legal frameworks to oversee biotechnology development through safety measures.
- The Cartagena Protocol on Bio safety (2000) is a legally binding international agreement that provides the basic lineaments of bio safety regulatory frameworks.
- Talking about GMVs, WHO is organizing in three regions (Africa, Latin America and Asia) bio safety training courses related to potential release of GMV in the wild. The first course has been organized for Africa in Mali in November 2008.
- As coordinator of this course, I selected 18 participants from Africa and Indian Ocean Island
- The goal was to increase the awareness of African researchers and decision makers of challenges related with the developmental and implementation of genetically modified disease vector control methods. The course covered issues related to the feasibility of engineering transgenic refractory mosquitoes and fitness in natural conditions. The course emphasized on evidences of the efficacy and safety of GM vectors and began to build public awareness and confidence. Ethical, legal and social issues have been properly addressed.
- In this presentation I will try to talk about Arthropod Containment level in Insectaries
- When arthropods are used, facilities, trained staff and established practices must be in place to ensure appropriate safety and the protection of health and well-being of workers and the environment.
- There are 4 levels of Arthropod Containment ACL1,2,3,4.

Escaped Arthropod distribution & infection Status

*Three fates of arthropod upon accidental escape

-Inviable → reproduction does not occur

-Transient → conditions vary Arthropod could reproduce but would be eliminated.

-Establishment → escaped arthropod could be expected to persist

*Escaped Arthropod Infection Status

-Uninfected

-Infected with non-pathogen

* Active vector Borne Disease Cycling.

According to the above situations, Arthropod Containment Levels have to be decided in insectaries

Arthropod Containment Level1 (ACL-1)

- Uninfected vector or infected with no-pathogen
 - Indigenous, exotic inviable or Transient.
- Standard Practices
 - *Location of Arthropod*: prevent accidental contact & release are minimized
 - *Supply storage*: allow detection of escaped Arthropod
 - *General arthropod elimination*: cleaning work surface
 - *Primary container cleaning & desinfestation*: heated or chilled at lethal temperature.
 - *Primary container construction*: screened, non-breakable
 - *Disposal of arthropod*: wastes are transported from the insectary in leak-proof, sealed containers, material may be killed before flushing down drain.
 - *Primary container identification and labeling*: species, strain, origin, date of collection, investigator attached to the container...
 - *Prevention of accidental dispersal on person or via sewer*: Prevent dissemination from insectary on their person or via the sewer.
 - *Pest exclusion program*: A program to Prevent the entrance of wild arthropod.

Arthropod Containment Level1 (ACL-1) continuation 1

- *Escaped arthropod monitoring*: Arthropod trapping program to monitor the escape prevention
- *Source and harborage reduction*: harborage and breeding area are reduced
- *Microbiological & medical sharps*: syringes and needles are used when appropriate
- *Notification & signage*: aware of the presence of arthropod vectors

* Special practices:

- *IACUC* approval for vertebrate used as host and *IBC* approval for non-exempt recombinant DNA protocols.

- Housing of non-arthropod animals: animal for blood feeding may be housed within the insectary.

Containment during blood feeding: arthropod fed on host animal are prevented from accidental transfer to the host cage.

Blood source: use sterile blood to prevent arthropod infection & transmission.

Arthropod Containment Level1 (ACL-1) continuation 2

- Escaped arthropod handling*: killed or properly disposed
- Accidental release reporting*: The insectary director is notified of accidental release of vector

*Safety equipment (primary barriers)

- Gloves*: when handling animal or blood to feed arthropod
- Torso apparel*: white laboratory coats are worn in the insectary at all time
- Arthropod-specific personal protective equipment*: respirators, masks, head covers...

*Facilities (secondary barriers)

- Location of insectary*: Insectary area is separated from general traffic within the building
- Insectary doors*: minimize escape and entrance of arthropod
- Insectary windows*: if present, prevent escape of the smallest arthropod

Arthropod Containment Level 2 (ACL-2)

- Practiced if working with;
 - exotic and indigenous arthropod infected with BSL-2 agents
 - Uninfected GM arthropods vectors
 - ACL-2 builds upon the elements of ACL-1. Moreover,
 - Access is more restricted than ACL-1

*Standard practices

-Location of arthropods: located in a way such as accidental contact and release by laboratory workers is unlikely.

Supply storage: the area is designed & maintained to enhance detection of escaped arthropod.

General arthropod elimination. As per ACL-1

Primary Container Cleaning and Disinfestation: in addition to cleaning as in ACL-1, disinfection is done chemically, by autoclave, or incineration

Primary Container Construction: cages used to hold arthropod are non-breakable, opening designed to prevent escape during removal or introduction

Arthropod Containment Level 2 (ACL-2) continuation 1

- *Disposal of Arthropods*: In addition to standard ACL-1 practices, infected arthropods are autoclaved or incinerated.
- *Isolation of Uninfected Arthropods*: Isolating infected material in a separate room.
- *Primary Container identification and labeling*. As per ACL-1
- *Prevention of Accidental Dispersal on Persons or via Sewer*: before leaving the insectary wash hands ,not to disperse viable life stage into drainage. Destroy material by heating or freezing.
- *Pest exclusion program*. As per ACL-1:
- *Escaped Arthropod Monitoring*: Assess whether escape are occurring. When exotic arthropod are used exterior monitoring is recommended
- *Source & harborage Reduction*: harborage & breeding areas eliminated, equipment with water screened to prevent arthropod access.
- *Microbiological and medical sharps*. As per ACL-1:
- *Arthropod sharps*: minimize arthropod sharp, restricted for use in the insectary if infected material are used

Arthropod Containment Level 2 (ACL-2) continuation 2

- *Routine Decontamination*: work area in the insectary decontamination with chemical or radiation (including soil or water for eggs)
- *Notification and signage*: Aware of the presence of arthropod. If infected material is present, BSL2- biohazard sign is posted on the entrance.
- *Procedure design*: prevent arthropod escape.
- *Safety Manual*: Safety material approved by IBC containing emergency procedures, standard operating, waste disposal.
- *Training*: Annual updates and additional trainings
- *Medical surveillance*: An appropriate medical surveillance program is in place. Personnel are aware of the symptoms of infection
- *Access Restrictions*:
- *Special Arthropod Handling Containers and Areas*: infected arthropods are prevented from release. A dedicated area for handling infected material is recommended.
- *Safe Transport in the Laboratory*: Transfer between manipulation & holding area is in non-breakable secure containers

Arthropod Containment Level 2 (ACL-2) continuation 3

*Special practices

- *IACUC and IBC approval*

Housing of Non-arthropod animals: other animal are not accessible to the arthropods. Animal used as host for blood are not housed with arthropod

- *Containment during blood feeding:* ACL-1 containment of arthropods during blood-feeding are more stringently assured

- *Blood source. AS PER acl-1*

- *Escaped arthropod handling:* loose arthropod must be killed, recaptured

- *Accidental release:* reported to the insectary director

- *Movement of equipment:* decontaminated before transfer between rooms within in insectary

*Safety equipment (primary barriers)

- Eye and face protection, Gloves, Torso apparel...
- Personal clothing: should minimize the area of exposed skin
- Arthropod-specific personal protective equipment

Arthropod Containment Level 2 (ACL-2) continuation 4

*Facilities (secondary barriers)

-*Location of insectary*: separate buildings, wings suites, two self-closing doors
-*Insectary doors*: entrance is via double-doors that prevent flying and crawling arthropod escape.

-*Insectary windows*: if present cannot be opened

-*Vacuum systems*: outlet fitted with suitable barrier

Interior surface: light colored

Floor drains: modified to prevent accidental release or survival of arthropod

Plumbing and electrical fixtures: To be minimal since they provide hiding places

HVAC: Ventilation appropriated

-*Sterilization equipment*: An autoclave available

-*Sink and Showers*: with hot water and suitable plumbing to prevent escape

-*Illumination*: appropriate for arthropod maintenance

-*Facility compliance monitoring*: evaluated annually for compliance to ACL-2

Arthropod Containment Level 3 (ACL-3)

- Involves practices suitable for work with potential or known vectors that are or may be infected with BSL-3 agents associated with human disease.
- ACL-3 builds upon requirements of ACL-2. It differs in that access is more restricted.
- Working with BSL-3 pathogens needs the use of biological safety cabinets.
- Manipulating small arthropod in a biosafety cabinet can be difficult.
- To prevent arthropod escape work is performed in a designated area.

* Standard practices

- Location of arthropods*: Furniture & incubators located in areas for BSL-3
- Supply storage*: closed room, doors and drawers are open only during access
- General arthropod elimination*: Trained & equipped to work with BSL-3 agents
- Primary container cleaning and disinfestation*: autoclave or incinerate
- Primary container construction*: prevent escape during removal or introduction
- Disposal of arthropods*: waste material to be, autoclaved or incinerated
- Isolation of uninfected arthropods*: If possible, ACL-3 procedures are housed in ACL-3 insectary.

Arthropod Containment Level 3 (ACL-3) continuation 1

- *Primary container identification and labeling. As per ACL-1*
- *Prevention of accidental dispersal on person or via sewer: taking care not to disperse viable life stage into drainage systems*
- *Pest exclusion program. As per ACL-1*
- *Escape arthropod monitoring: records of exterior capture are maintained*
- *Source & harborage reduction. As per ACL-2*
- *Microbiological and medical sharps*
- *Arthropod sharps*
- *Routine decontamination. As per ACL-2*
- *Notification & signage. As per ACL-2*
- *Procedure design: procedures performed to prevent arthropod escape*
- *Safety manual. As per ACL-2*
- *Training: under ACL-3 is more detailed and BSL-3 certification is required if infected material are handled*
- *Access restrictions: access to the fewest number*

Arthropod Containment Level 3 (ACL-3) continuation 2

- *Special arthropods handling containers and areas: All work in primary barrier.*
- *Safe transport in the laboratory. As per ACL-2*
- * Special practices
- IACUC and IBC approval. As per ACL-2
- *Housing of non-arthropod animals. As per ACL2.*
- *Containment during blood-feeding. As per ACL-1*
- *Blood source. As per ACL-1*
- *Escaped arthropod handling: killed and disposed of or recaptured*
- *Accidental release reporting. As per ACL-2*
- *Movement of equipment. As per ACL-2*
- *Inventory of arthropods. The number of arthropod must be include on the label. Vessel with low mobility stage shouldn't be stored within ACL-3 insectary.*
- Safety equipment (primary barriers)
- *Eye & face protection As per ACL-2, Gloves, Torso apparel, Foot apparel, personal clothing. As per ACL-2. Arthropod-specific personal protective equipment. As per ACL-2*

Arthropod Containment Level 3 (ACL-3) continuation 3

-*Pesticide*: available to kill escaped arthropods

* Facilities (secondary barriers)

-*Location of insectary*: isolated. *doors*; limited to trained, double door (air locked). *windows*: not recommended

-*Vacuum systems*. As per ACL-2

-*Interior surfaces*: made in manner to facilitate decontamination

-*Floor drain*; not recommended

-*Plumbing & electrical fixtures*. As per ACL-2: *HVAC*: exhaust must be dispersed away from occupied area, audible alarms alert to system failure

-*Sterilization equipment*: Autoclave available

-*Skin and Shower*, + ACL-2 recommendation, plumbing is available in insectary

-*Illumination*. As per ACL-2-

Biosafety cabinets: Air from Class II biological cabinets can be re-circulated into insectary. If class III cabinets are used they must be installed appropriately

-*Facility compliance monitoring*: ACL-3 insectary design and operational procedures must be documented PI and reviewed by IBC. Insectaries are re-verified at least annually.

Arthropod Containment Level 4 (ACL-4)

- ACL-4 safety guidelines are for the most dangerous pathogen infected arthropods. BSL-4 agents are associated with a high risk of infection. BSL-4 requirement must be strictly followed.
- On the 12 viruses requiring BSL-4 containment, 5 are transmitted by arthropods (Central European Encephalitis, Congo-Crimean hemorrhagic fever, Kyasanur Forest disease, Omsk hemorrhagic fever, and Russian Spring-Summer encephalitis)
 - Only ticks are implicated in their transmission so that containment measures related to ticks must be at BSL-4.
 - The number of BSL-4 laboratories is quite limited and they are 2 types:
 1. The cabinet laboratory where agent is handled in Class III biological cabinet
 2. The suit laboratory.
 - When used in a BSL-4 facility, an arthropod must never be handled outside. A specific person well trained has to be designated for working ACL-4 level. ACL-3 equipment will be specially adapted for ACL-4.