social bugs

Rearing Crickets

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1. Introduction

This protocol is intended as a practical guide for setting up and running a small-scale cricket farm. It is aimed at anyone interested in rearing house crickets as a sustainable protein production. This protocol guide is based on a combination of available scientific literature and our own experience from several years of working hands-on with small-scale cricket rearing. Our purpose with this protocol is to make it easier for others to get started and contribute to the development of more cricket farms. The protocol is published as part of the Social Bugs project, co-funded by the European Union (Erasmus+ ID 2024-1-DK01-KA220-VET-000251164).

2. What is a cricket?

The life cycle of the house cricket (with the scientific name *Acheta domesticus)* can be divided into three life stages: egg, nymph and adulthood. It normally takes 10-13 days for the egg to hatch into nymphs. It takes between 6-8 weeks (42-56 days) for newly hatched nymphs to reach adulthood at suitable conditions of temperature, humidity and feed. An illustration of the life cycle of *A. domesticus* is shown in Figure 1. The weight of a fully grown female cricket at harvest is normally between 350-414 mg, which is slightly heavier than the male cricket with a weight of 250-300 mg. Crickets undergo incomplete metamorphosis, meaning they do not enter a pupal stage. Before reaching adulthood, the cricket undergoes 8-12 molts, known as instars. When male crickets reach adulthood, their wings fully develop. This allows them to use the wings for mating chirps, the distinct sound most people identify with crickets. Female crickets will begin to deposit their eggs a few days after reaching adulthood using their ovipositor, which originates from the abdomen. They prefer to deposit their eggs in a damp substrate, such as moistened coconut fiber, to hide the eggs from male crickets. A single female cricket can lay between 50-100 eggs every 2-3 days after reaching maturity. Under optimized rearing conditions, cricket farmers can achieve 8-10 production cycles annually.

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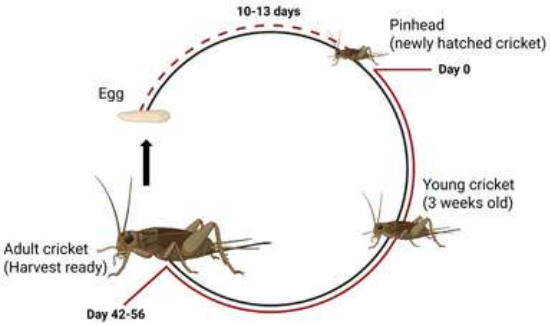

Figure 1: *The development of the cricket from egg to adult. Life Dashed red line illustrates number of days (10-13) for the egg to hatch. Red line illustrates number of days from newly hatched crickets (pinheads) to adulthood/harvesting stage (42-56 days). Figure made in Biorender.com.*

3. Why rear crickets?

House crickets are among the edible insect species gaining attention in circular economy by converting side-streams and food waste into a food ingredient rich in protein and other nutrients. Crickets are used as an alternative protein source in human diets and are also widely used as feed for reptiles, birds, and fish. They contain up to 65% protein (on a dry-matter basis) and a significant amount of fats, along with essential micronutrients such as iron, zinc, and vitamin B12. Due to their rapid growth rate and low environmental footprint, they represent a sustainable alternative to traditional animal protein.

While black soldier fly larvae (*Hermatia illucens*) (BSFL) and mealworm (*Tenebrio molitor*) are better at converting low value side-streams into biomass, making them more suitable as animal feed, house crickets may be more appealing for human consumption due to their higher nutritional value, such as higher protein and vitamin B12 content compared to other edible insect species. Crickets are still a niche product in the food industry, but are considered the edible insect with the highest potential as food due to their appealing flavour, appearance and strong nutritional profile , including all essential amino acids.

4. What do you need?

4.1. Infrastructure

4.1.1. Rearing room

House crickets grow best when their environment is warm, dry and stable. Since they are cold-blooded animals, the temperature in the room has a strong influence on the growth rate, survival and reproduction of crickets. The ideal temperature for rapid growth is around 30 °C. This temperature also improves the chances of eggs hatching, leading to more crickets from the same number of eggs. If the temperature drops below 25 °C, the crickets will grow markedly slower, and some may even die. If the temperature goes above 34 °C, crickets can become stressed or sick, and ultimately die, which emphasizes the importance of keeping the temperature in the room within the correct range. Also, even minor variations in temperature (such as 1-2 degrees) may result in delays of several days in reaching maturity.

Crickets do not need light to grow and thrive in dark conditions since they are active at night in nature. Some producers use a 12-hour light/12-hour dark cycle. Maintaining appropriate humidity levels is essential for successful cricket rearing. Relative humidity should be kept between 40% and 60%. Levels below this range can cause desiccation of eggs, leading to reduced hatch rates. Conversely, excessive humidity promotes the growth of mold and mites, which can negatively impact cricket health and hygiene. Use a humidifier or other environmental controls to maintain the correct humidity levels.

Efficient ventilation is also essential to ensure good air quality and maintain a stable environment. Crickets release gases such as carbon dioxide and ammonia, which can accumulate without proper airflow. A fan and ventilation system helps remove these gases, supply fresh air, and maintain even temperature distribution, particularly in spaces with high ceilings.

The density of cricket populations per box/container plays a critical role in growth, survival, and development time. These effects occur even when food and water are available ad libitum, indicating that crowding alone is a key factor. Early rearing density can also have long-term effects on development and fitness, so careful management is essential for optimal production.
In a small farm (e.g. a shipping container), these conditions can usually be managed with a well-insulated room, a basic air-conditioning unit that can heat and cool, a humidifier, de-humidifier, and some simple fans. More sophisticated (and expensive) equipment is not essential, although it could provide minor

improvements — just make sure the room stays warm, not too dry or humid, and has some airflow.

In larger industrial setups, producers typically have separate rooms for different stages of the cricket's life cycle and a more high-tech setup to control ventilation, temperature and humidity.

4.1.2. General work room

Besides the rearing room there is a need for a separate place to perform many of the various tasks related to cricket rearing such as preparing the different rearing boxes, preparing the feed substrate, clean boxes, harvest the crickets, etc. This should not be done inside the rearing room.

4.2. Equipment and hardware

4.2.1. Equipment for handling crickets

Plastic boxes used for production	Small box (used for pinheads) (46x36x25 cm)  Large box (used as hatcling and production box) (73x54x40 cm) 

Plastic box for water and feed	Small condi box: (19x12x7 cm) 
Plastic box used in handling and harvest	5L condi box: (19,5x19,5x19 cm) 
Plastic lid for feed for hatchlings	
Water source for pinheads	Centrifuge water tube 

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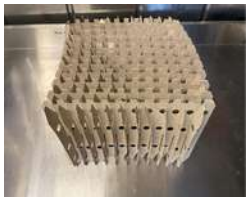
	Cotton to place inside the water tube 
Cricket condos	35 cm x 35 cm 
Egg cartons	
Coconut coir	Used for egg-laying and damp substrate 

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Cricket ladders made out of egg carton	
Humidifier	
Dehumidifier	
Heat pump	

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4.2.2. Hardware used in the container

Scale	
Grinder	

4.3. Feed and water

4.3.1. Water

Water can be provided in different forms depending on the age of the cricket. At the life stage as pinheads water is provided through water tubes in the hatchling box (see Chapter 5.1).

When the crickets are 3 weeks of age, water starts being provided through the moist coconut coir in the production box (see Chapter 2 for production box). Crickets are sensitive to variations in the water quality (e.g. the disinfectants sometimes found in water). Therefore, inferior water quality may lead to suboptimal growth

4.3.2. Feed

In EU legislation, insects are defined as farmed animals like cattle, pig and poultry, and can only be fed approved feed substrates such as grain, soybean meal, silage, as well as leftovers from fruit, vegetables and bread. It is prohibited to feed insects with animal products, kitchen/catering waste and livestock manure, to name a few. However, some materials of animal origin such as milk, eggs and

derived products, honey, rendered fat or blood products from non-ruminant animals are exceptions. Chicken feed is currently the most used feed in commercial cricket production. Even though it cannot be considered particularly sustainable, it has so far proven to be the only feed that yields effective growth and survival. Chicken feed typically arrives in pellet form, and to avoid the house crickets carrying the feed around the production box, the pellets should be milled prior to feeding the crickets using a grinder. However, it is possible to just provide chicken pellets at early stage (i.e. to pinheads), since the crickets are too small to carry the pellets around at that point. Just as with water, it is also important that feed is provided ad libitum for crickets as they are cannibalistic and will start attacking and eating each other if feed is limited.

5. The rearing process

5.1 Egg to pinheads (pinhead box)

A hatchling box is a large box containing capillary boxes (see figure 4) that adult crickets have been depositing eggs into – and now filled with eggs. These eggs will normally hatch into pinheads after 10-13 days. In order to create a hatchling box, you will need following:

Materials

- 1 large box
- 9 capillary boxes (originated from production boxes where adult crickets have deposited eggs in)
- 5 water tubes

Setup and procedure

Place 9 capillary boxes that have been used by mature crickets for laying eggs (see below) from the production boxes you have harvested for crickets and place them in a large box and add water tubes. This is now a *hatchling box*. After 10 days, the first pinheads will begin to appear in the box. Over the course of a maximum of 4-5 days after the first pinheads appear it is time to transfer the pinheads to small boxes.

5.2. Small boxes (newly hatched crickets)

BOX 1: Skipping small boxes

NB! The use of small boxes as described in 5.2 is primarily a space-saving measure. Should you have ample space in your farm and no need to maximize output, you can skip Chapter 5.2 and go directly from Chapter 5.1 to Chapter 5.3 with the following exceptions:
·When moving crickets directly from pinhead boxes to production boxes, you still have to prepare 5 water tubes as described in Chapter 5.2. However, the water tubes are placed in the production box for the first 3 weeks of growth, with 4 water tubes placed on top of the cricket condos and 1 water tube placed on the bottom of the box, next to the cricket condos between the feed and coconut choir.
·Similarly, add extra feed to the production box by placing a lid with feed on top of the condos and another lid with feed at the bottom of the box, next to the condos.
These steps ensure that the pinheads can still find feed and water despite their small size.

5.2.1. Preparing a small box for pinheads

A small box is used for newly hatched crickets (called pinheads) until they reach the age of 3 weeks. In order to create a small box for pinheads, you will need following materials:

Materials

- Clean small box
- Five clean 50 mL centrifuge water tubes
- Cotton for sealing of water tubes
- Three egg cartons
- 2x Clean Square lid (from condi boxes)
- Chicken feed in pellets
- Two pieces of egg carton to form a ladder for the hatchlings to reach the feed.

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Figure 2: *Materials prepared for the small box containing pinheads: Egg cartons, two lid with chicken feed pellets and five prepared water tubes*

Setup

To prepare the water tubes, add water until the 40 ml mark. Then fill the top part of the water tube with cotton. The right amount of cotton is largely a subjective judgement, as it should be just enough cotton to form droplets, but not too much should pass through, since the hatchlings will drown. The cotton should approximately reach the 35 mL mark on the tube. Use a dry piece of paper towel to remove excess water that might run from the cotton and down the side of the tubes.

Place one lid/tray on the bottom of the box under the egg carton. All egg cartons are later placed on top (see next paragraph). The other lid/tray is placed in the front end of the box where no egg cartons will be located. Fill the lids with chicken feed pellets. Then form ladders from pieces of egg carton to allow the pinheads to reach the feed.

Place three water tubes in the bottom of the small box and an egg carton on top of them. Then place a single water tube on top of the first egg carton and place a second egg carton on top. Place the last water tube on the second egg carton and place the last egg carton on top.

Figure 3: *Inside the small box – illustrating the placement of water tubes and feed*

5.2.2. Transferring the newly hatched pinheads from the hatchling box to small boxes

Remove water tubes. Gently tap on each capillary box to ensure as many pinheads as possible will jump into the small box. Then transfer the capillary box into another box (e.g. a small or large box) to ensure no remaining pinheads escape. When all capillary boxes have been moved from the hatchling box, only pinheads will be left in the box. Gather all pinheads in the corner of the hatchling box. From there, transfer all pinheads into a 3 L box and weigh the total biomass. From there pinheads can be divided into portions of 3 grams. Transfer pinheads into a weighing box (3 L box) until it reaches 3 g and subsequently transfer them to a small box.

5.1. Production boxes (3 weeks and until harvest)

After approximately 3 weeks in the small box, the pinheads have grown from tiny crickets to medium sized crickets. It is now time to transfer them to large boxes where they will stay until harvest. These boxes are called production boxes.

5.3.1. Preparing the production box

The production boxes should be prepared prior to transferring the crickets from the small box.

Materials

- Clean large box
- 2 cricket condos
- One capillary system (see box 2)
- One 780 mL box with grinded chicken feed
- Egg carton to form ladders

BOX 2: Capillary system

The system consists of a two-box system, where a 780 mL box, with a slit, is inserted into a 1200 mL box. The large 1200 mL in the bottom should be filled with water. Insert a cut piece of fabric cloth in the slit to form a wick that will allow water to the top box from the bottom box. The top 780 mL box should be filled with moist coconut coir. When making large quantities of capillary systems they can be prepared beforehand (see picture x).

Figure 4: *Setting up the capillary system*

Setup

Place two cricket condos next to each other in the production box, push them all the way to the back of the box, leaving enough space to fit feed and capillary boxes in the front. Then place the box with grinded chicken feed in the bottom of the free corner in the box. Place the capillary system in the other side of the box. Similar to the hatchling box, create paths/ladders for the crickets to get access to the feed and water with pieces of egg carton. Make sure the egg carton ladders are not in contact with the coconut coir, since the crickets will chew up wet cardboard.

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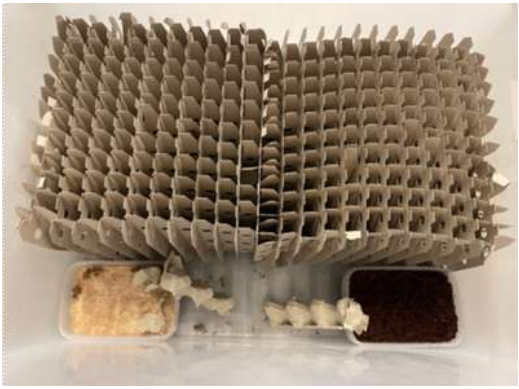

Figure 4: *Inside the small box – illustrating the placement of water tubes and feed*

Transferring the three-week-old crickets to the production box

- ☐ Remove the lid with feed from the small box. Make sure all crickets are removed from the feed and no feed pellets are transferred to the production box.
- ☐ Remove all crickets attached to pieces of egg carton used as ladders by banging the carton gently or flicking it and subsequently remove the small pieces of egg carton.
- ☐ Remove the top large egg carton by gently tapping the crickets off so they fall back into the box.
- ☐ Remove the water tube by gently banging the tube against the side of the box or by flicking it with a finger to remove crickets. Repeat this procedure with all egg cartons and water tubes.
- ☐ To achieve the optimal density of crickets, transfer 53 g ± 2 g of crickets (aprox. 4-5000 individuals) to the production box.

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BOX 3: Cricket Density

Studies show that high densities (≥0.47 crickets/cm²) can lead to lower survival rates, smaller body size, and increased risk of disease due to stress and higher pathogen transmission. In contrast, a low density (0.19 crickets/cm²) has shown to result in larger crickets and improved overall condition.

5.4. Harvesting the crickets

At approximately 6-8 weeks after hatching, when the first adult individuals start to emerge, the crickets are ready to harvest. Good indicators of when they are ready for harvest is when you start hearing them chirping and the wings of males and ovipositors of females are fully developed (see figure 6). Once the crickets have reached this stage, it is advisable not to delay harvest, since cannibalism increases once the crickets are adults.

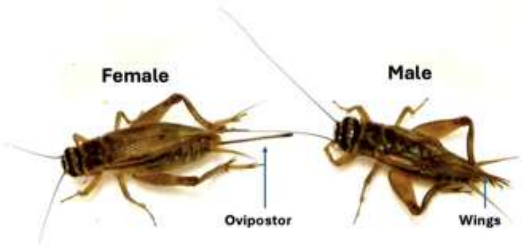

Figure 5: *Illustration of a fully devoleped female and male house cricket*

Procedure

Twenty-four hours prior to harvest, remove feed from the production box to allow for gut-unloading before harvesting. If practically possible in your production set-up, lower temperature in the container to 15°C three hours prior to harvest to reduce activity of the house crickets.

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Materials

- Two clean small boxes
- 5 L Condi box for freezing (one 5 L box typically contains the entire content of x kg in a production box)
- Garbage bags for condos
- 4 clean egg cartons

Harvesting the crickets

☐ 1) Start by removing all ladders from the production box and discard them:


☐ 2) Lift the capillary box and feeding box and make sure to remove the crickets before removing the boxes from the production box:


- [ ] 3) Now remove one condo at the time by grabbing diagonally opposite corners of the condo, so that the condo does not collapse. Gently shake the condos to release all crickets from the condo and remove it from the production box.


- [ ] 4) Repeat with the other condo in the box and discard them:


- [ ] 5) Now, all crickets are roaming freely in the box and will immediately look for cover:

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☐ 6) Place all 4 egg cartons vertically in the box and let the crickets crawl onto the egg carton. Only live individuals should crawl onto the carton (the proces is repeated in step 7 to make sure only live individuals are harvested):


☐ 7) Gently transfer the egg cartons filled with crickets to the first small box and gently bang the egg carton against the side of the box to remove the crickets:


Repeat with other egg cartons and return cartons to the production box if many crickets remain.

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☐ 8) It is important to make sure, that dead crickets are not carried over into the edible population. Therefore, steps 5 and 6 are repeated. When (nearly) all crickets are moved to the first small box, gently and slowly place one egg carton on top of the layer of crickets, so they can reach and crawl on to the egg carton:

☐ 9) When the egg carton is half-covered with crickets crawling on it (it will feel heavy), gently transfer the egg carton to the second small box. Shake the egg carton and gently bang on the side of the box to release the crickets into the second small box:

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☐ 10) Keep repeating these two steps until healthy individuals are in the second box:


☐ 11) When (nearly) all house crickets are transferred to the second small box, transfer all crickets to a 5L Condi box, put the lid on and ID the box with batch nr., harvest date and weight:


☐ 12) Transfer the 5L Condi boxes to a freezer (-18°C) dedicated to killing house crickets. The crickets should be left at -18°C for at least 12 hours prior to further processing.

5.5. Reproduction

Keep 10 % of "ready for harvest" crickets in production boxes with the cricket condos. Place two capillary systems and one box with feed next to the cricket condos. Add some veggies (or other alternative source of water than coconut coir) together with the capillary systems and feed. After 48 hours, the capillary systems will be packed with eggs and are removed from the production boxes and placed in a hatchling box (see Chapter 5.1). Only allowing 48 hours for eggs to be laid has the added advantage that pinheads will be the same age when hatching and mature at approximately the same time.

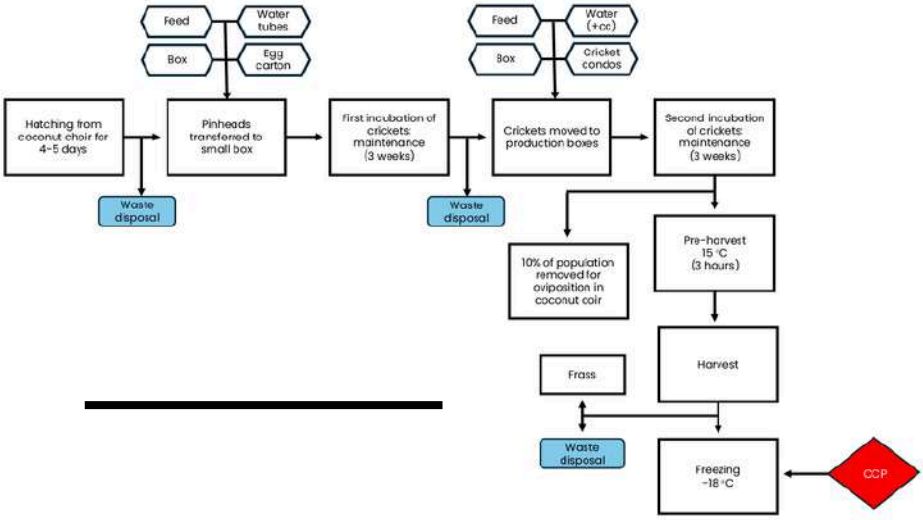

Figure 6: *Flow chart over the production steps in the rearing of House crickets in a production container. CC indicates that water is provided with coconut coir. The final freezing step is a critical control point (CCP) where crickets must be stored at minimum -18 °C for minimum 12 hours.*

6. General maintenance of cricket production

6.1. Small boxes

6.1.1. Water change

Water tubes should be changed once per week. Carefully lift all three egg cartons and remove the three bottom water tubes and gently tap them against the side of the box to remove all hatchlings from the cotton. Collect all tubes in a clean box. Remove old cotton and discard it. Pour out water that might remain in the tube. Refill the tubes with clean water and place pieces of cotton as a lid.

6.1.2. Feed change

Once per week, boxes are checked for remaining feed. Feed should be added when needed, so the house crickets have feed available ad libitum.

6.2. Production boxes

6.2.1. Water change

Water is provided to the crickets through a capillary system (described in Ch. 5.3.1), where additional water is provided in the lower box of the set-up. Additional water should be refilled regularly as needed. The coconut coir should be changed every fortnight: Collect all capillary systems from production boxes. Empty all water and coconut coir from capillary boxes, which should be discarded as regular waste. Set up new fresh capillary systems using clean boxes.

6.2.2. Feed change

Feed is added to boxes regularly to ensure feed ad libitum. There is a tendency of the feed forming layers in the box, with an inedible layer on top consisting of large flakes, that the crickets seem to avoid. So, before addition of any new feed, stirring the feed can provide the crickets with access to the edible part. Use a clean spoon or a clean glove wearing hand to stir up the layers.

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7. Achieving frass as a by-product

After harvesting all the living crickets, the production box will contain a mix of dead crickets, frass and molts. To harvest the frass, sieve the content of the production box with a 1 mm sieve and down into a small box, so only the frass will be left in the small box. The frass needs to be heated at 70°C core temperature for an hour before commercial use. Check locally whether you need to be certified to use the frass commercially. Otherwise, the frass should be discarded as regular waste.

The frass from insects, has been proven to work well as an organic fertilizer and soil improver, providing plants with nitrogen, phosphorus and beneficial microbes. Studies show that it can promote healthier root growth and improve soil structure.

8. Problems and challenges

8.1. Allergies

Consumer Risks

House crickets (Acheta domesticus) are closely related to crustaceans and dust mites. People with shellfish or dust mite allergies may experience allergic reactions when consuming crickets. It is essential to include a clear allergy warning on product packaging.

Worker Risks

Continuous exposure to cricket frass (feces), shed skins, and body parts can cause respiratory or skin allergies in rearing staff. Symptoms may include sneezing, itchy eyes, skin irritation, or asthma-like reactions.

Precautions:

- Wear personal protective equipment (PPE): masks (at least FFP3)/respirators, gloves, and long-sleeved clothing.
- Ensure adequate ventilation and use air filtration systems in rearing areas.
- Provide regular health monitoring for workers handling large cricket populations.
- Limit exposure time and encourage good hygiene practices (handwashing, changing clothes after work).

8.2. Diseases in the cricket population

Viral Threats

Densovirus is a major pathogen in crickets, causing high mortality and collapse of entire colonies. Infected populations often show slowed growth, lethargy, and deformities.

Stress Factors

Overcrowding, poor ventilation, inadequate temperature, and irregular feeding can weaken cricket immune defenses, making them more susceptible to infections.

Prevention & Management:

- Maintain optimal density, temperature, and humidity.
- Implement strict biosecurity (restrict entry, disinfect equipment, quarantine new stock).
- Remove and dispose of dead or sick crickets daily.
- Consider routine monitoring and lab testing for pathogens if rearing at scale.

8.3. Pests

Rodents, flies, moths, and mites can infest cricket facilities, spreading disease and damaging stock.

Prevention & Control:

- **Facility Design:** Seal cracks, install fine mesh on windows/vents, use pest-proof containers.
- **Monitoring:** Use traps to monitor rodent and insect presence.
- **Cleaning Routine:**
  - **Weekly:** Remove uneaten feed, clean trays, disinfect water systems, vacuum frass when experiencing issues with pests such as flies and moths.
  - **Monthly:** Deep clean enclosures, replace substrate, disinfect tools and equipment.
  - **Yearly:** Full facility sanitation, structural checks for pest entry points, and replacement of damaged equipment.
- **Rodent Control:** Use traps rather than poisons to avoid contamination of crickets.
- **Fly/Moth Control:** Reduce organic waste, use sticky traps, and ensure feed is stored in sealed containers.

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