Insect Farming for Fun or Profit: The Basics of Farming Crickets

Highfield

Growing Crickets for Fun or Profit

Introduction

Farming insects is becoming popular, especially for producing insects for human consumption, especially crickets. Crickets are easy to rear and can be kept in a number of ways. There is no one right way or wrong way, instead simply tailor your methodology to the space you have, the numbers you want to grow (from grams to tonnes!) and the effort you want to put in. Here the processes are described to grow crickets at small and large scales, along with some of the pitfalls that you may encounter. If you are planning to setup a commercial operation, see the more detailed documents on our website.

Equipment you will need

1. Containers to keep them in. Plastic storage boxes are good and cheap.
2. An insulated and ventilated space with some form of temperature and humidity control that generates stable conditions of temperature and humidity (not to hot, not too cold @35°C max, 20°C min).
3. A cheap, suitable and abundant foodstuff.
4. A degree of understanding of the life-cycle of the insect.
5. A place to handle crickets outside of the rearing area (commercial operations)
6. A means of killing and processing them (for crickets destined for food or feed).
7. Tweezers, measuring cylinder, disinfectant, marker pens etc

Some Background

There are many species of crickets but they all share similar life cycles. Here I base this summary on the brown house cricket *Acheta domesticus* but other species are similar. A brief understanding of the cricket's life-cycle is necessary in order to understand the acquirements of a cricket farm.

The best cricket for farming in industrial numbers is *Acheta domesticus* but in Europe most colonies of this species suffered from a virus that severely compromises productivity. We have developed a method for getting rid of the virus, however (we are the only ones who can do this but we can show you how). Other species can be used, however, such as *Grylloides,* but these are inferior in many respects). **If you have virus/disease problems, contact us or see our website for details of how it can be solved.**

SECTION 1. REARING CRICKETS

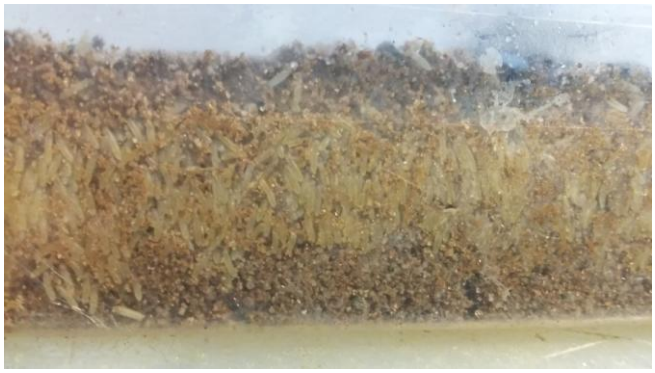
Starting the colony

Often the easiest way to start a colony is to purchase crickets from a live-foods producer of which many are available and sell online Generally, insects will be provided as immature nymphs and will need to be reared to the adults stage for you to start breeding them. The following takes you through the processes you need to establish a colony (small or large) and is appropriate to most species of cricket routinely reared either at home or commercially. The insects can be placed in an appropriate container with harbourage and provided with food and water, as described below). The eggs produced by these first crickets, and all subsequent generations, can be collected as described in section 3 (below). Remember to always keep things as clean as possible to maintain health of your insects

Collecting eggs

The lifecycle of the cricket starts with the egg, which are laid into a damp substrate, such as sand or soil. It is best if the substrate is relatively sterile to prevent microbial growth, mould etc and a wide variety of materials are used. Some use damp moss, for instance, or soil A few hundred adults (the females have long ovipositors (egg laying pipe) and, in the case of *A. domesticus*, fully developed wings) will lay many thousands of eggs into the substrate over a 24 hour period.

Below is an example of an egg collector that can be used, made out of a plastic ice-cream container:



Egg collection. Crickets laying eggs in fine builders' sand (top). Eggs are readily visible around the edge of the clear plastic container (bottom). Some cover the egg-laying substrate with a mesh to prevent the crickets eating the eggs although this is not always required.

The eggs are then incubated until hatch at a stable temperature to ensure a predictable hatch time. This means keeping the eggs in a warm place and ensuring that the medium that the eggs were laid into remains damp (but not too wet, the eggs will drown). If the eggs dry out they will die so keep a good eye on the eggs. Place a lid over the top of the container holding the eggs and pierce this with lots of small holes. This will allow gas exchange and, if the nymphs start to hatch, keep them in place.

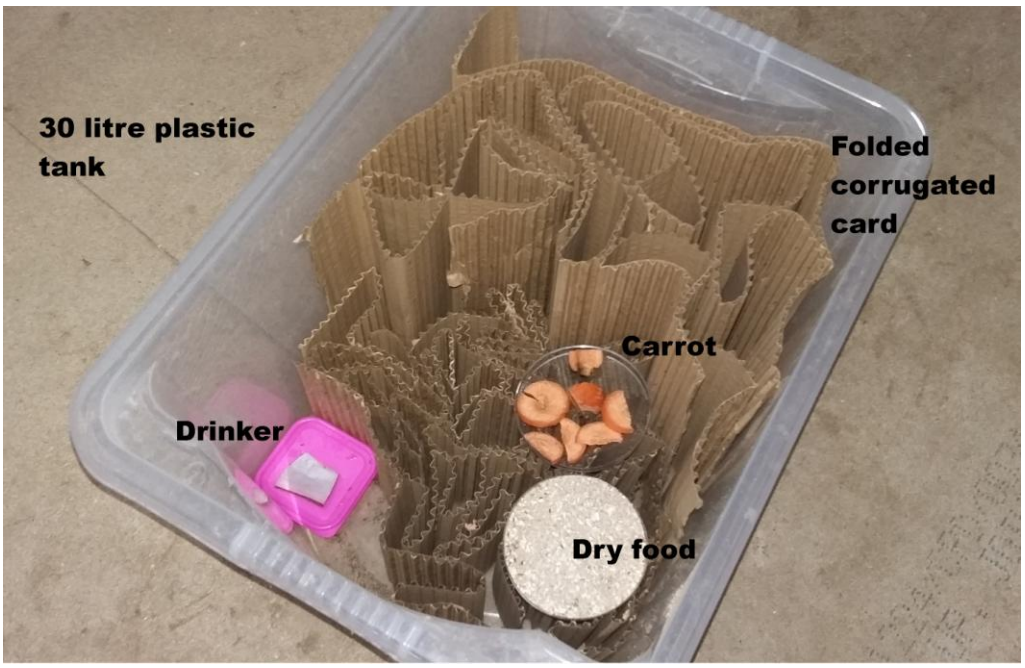
A simple incubator to help control the duration of egg development can be built for around £200 (See "Establishing a High Volume Cricket Farm). The eggs will hatch after about 10-12 days at temperatures above 30°C but will take much longer at lower temperatures, sometimes as long as a month.

Just before the hatch time (about 12 days), the egg pot should be put in a suitable container to collect the nymphs (baby crickets) as they emerge. This can be a suitable pot, box or a small plastic tank, depending on the size of your cricket operation. The nymphs will hatch out over a 24-48 hour period. The picture below shows newly hatched nymphs in a 30 litre plastic tank, purchased from a hardware store for around £5.00. Crickets are poor climbers and the insects should not crawl up the walls of the tank. If they do, a band of petroleum jelly around the inner walls of the tank will stop them.

Pinheads. Newly hatched *A. domesticus* nymphs

Rearing the nymphs (pinheads)

The newly hatched crickets are called nymphs, or “pinheads” due to their size, and remain small for about two to three weeks depending on temperature and about 5000 (about 15 mls) can be comfortably kept in a 30 litre tank as long as they have plenty of harbourage (card or similar) within which to hide.



A 30 litre tank with harbourage card, dry and fresh food sources and a drinker.

Provide the nymphs with fresh vegetable material in a shallow dish and a source of water (see later). A dry foodstuff, such as ground cereals and pulses increases growth rate and survival (the best food is commercial chicken feed or chick crumbs though this is expensive). Diets for crickets are detailed later. After about two weeks the nymphs will be in their third or fourth stage ("instar") and will be ready to go into a bigger container, or if the extra insects are not needed (e.g. for small colonies) they can be thinned out a bit at this point. To support a population of 5000 crickets to full size requires about 100 litres of space. A 110 litre tank is illustrated below and can be purchased for around £12. These tanks have the advantage of being moveable by one person and can be stacked three high on racks. The central part of the plastic lid has been cut away and replaced with fine nylon mesh (held in place via hot glue application) so that crickets cannot hop out. A tank such as this will yield around 2 kg of crickets 45 days or so post hatch.

For those who want to grow crickets on an industrial scale better solution would be to use 1000 litre Industrial Bulk Containers (IBCs) with their lids cut off and netting placed over the top to keep the insects in and other things out.

Harbourage - somewhere to roost

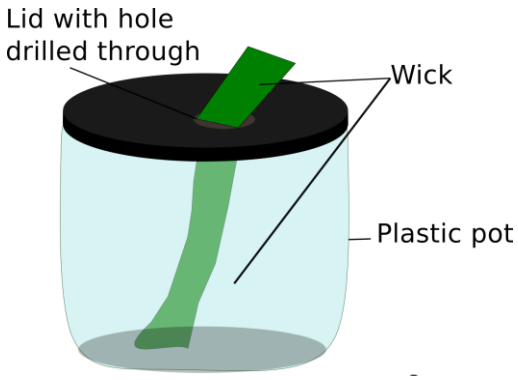
Crickets require places to roost and any cricket container must be filled with a material that provides a large surface area for the insects to hide amongst ("harbourage"). Many farms use egg trays for this purpose although these are costly and have a tendency to go mouldy

if conditions are damp. There is research that suggests that crickets require a minimum of 2.5 cm^2 of surface though It is probably better that at least double this space is available. Waste cardboard can be folded up to serve the same functions although it is less efficient in terms of creating a large surface area. It helps if the harbourage is arranged vertically, as shown in the picture, so that frass (cricket faeces) collect in the bottom of the tank). The examples shown earlier both use corrugated packaging card, folded and cut to approximately 2/3rds of the height of the tank (maximum) and 1/2 at the lower points. Examples of tank setups and harbourage are shown overleaf.

Water source

Crickets can get a proportion of the water they need from vegetables provided as food (carrots are probably the best). However, they generally grow better if they are provided with source of free water. Water drinkers for crickets can be readily made with low-cost items. These include jam jars with a hole punched through the lid to allow a tissue paper wick (or capillary matting strip) to be passed through into water held in the jar. A better system for higher volumes is to copy the design of chicken drinkers whereby the jar of water is inverted onto a dish containing an absorbent material (this can be tissue paper, cotton wool or fabric). Commercially available drinkers are available Care must be taken to keep the drinkers stable and level so they do not leak.

The exact design is unimportant and water drinkers can be made for negligible cost and the primary aim is to provide a source of water that requires only intermittent changing. The size will be dependent on what size of colony is being maintained. It must be noted that water drinkers rapidly become covered by dirt following the visitation of hundreds of crickets a day and, regardless of design, drinkers need to be changed on a relatively frequent basis (3-4 days) as the wick will become slimy. It important that, whatever drinker you use, that they do not leak as baby crickets will readily drown in pools of water, whilst in tanks holding bigger crickets damp will cause things to go mouldy.



Simple drinker. A plastic storage pot can be converted into a drinker. Drill a hole though the lid and pass an absorbent material through the hole (ensure the fit is good so no leakage occurs). A good material for making a wick is capillary matting available from horticultural suppliers. Tissue can also be used although this degrades more rapidly. Place the drinker next to harbourage so the crickets can access it

Tank setups. (Top) A 100 litre tank in place in the growing room with its mesh lid in place. (Left) The internal set-up of the tank with harbourage, food and water in place.
Note that to prevent escape, the harbourage does not extend to the top of the tank and a "headspace" is left. The dry food is presented on a aluminium foil baking tray. (Right) a similar set-up using a different type of harbourage and drinker

Maintaining the insects

Crickets can be fed as and when they require more food (*ad libitum*). It is best that food is presented to the crickets in shallow trays that allow a large number of insects to access the food simultaneously. Trays like the ones pictured above work well although you will note little bridges are provided to allow the crickets to climb onto the food – crickets are very poor climbers so often need such help. The food can be topped up when it becomes low which in the case illustrated was every two to three days. details of good foods for crickets are detailed later in this document.

Breeding stock

Once the insects have reached the desired size they can be culled or used as feed for pets etc. To maintain the population a proportion of insects will have to be retained to provide the breeding stock necessary to keep the colony going. In a very large colony it makes sense to have a separate breeding population but in small scale operations simply saving a proportion of insects in each generation will usually be fine.

Retain a proportion of crickets and they will moult into adults in about a 50:50 proportion of males and females. Females are readily differentiated as they have a long ovipositor (egg laying tube) protruding from their rear end. About one week after becoming mature the females will start laying eggs in the sand provided for the purpose. They will continue to lay eggs for around a month and can produce 500-1000 eggs. As such, a single population of 100 females can produce 10-20 thousand eggs per week, more than sufficient to maintain a population for home use. New adult tanks can be set up as and when they are needed.

For large scale populations the number of adult tanks can be simply increased to meet the demand for eggs

Rearing Room (home) / Building (commercial)

The room / building ideally needs to be well insulated to prevent heat loss if you are living in a cool region. For small colonies heat can be provided by tube heaters but in larger operations more extensive heating will be required. The room where the crickets are kept will also need decent ventilation as humidity will increase with population size. Humidity can be controlled by use of dehumidifying equipment very readily (and cheaply). Additionally, carbon dioxide produced by the crickets can build up to dangerous levels in well sealed rooms (if the population is large) unless air exchange to the outside is not maintained. For small-scale home populations of crickets, these issues will not be so much

of a problem but for high-volume colonies (i.e. commercial operations) keeping the air fresh is essential, both for the insects and for the safety of human workers.

To provide fresh air whilst at the same time retaining heat in a large room, a simple heat recovery extraction fan can effectively keep the air good whilst at the same time prevent heat loss for the cost of £200-300 (80% of the heat recovered) . A 2 KW heater will maintain a decent temperature in a relatively large room (at least 100 m^2) and, once the room is full of crickets, heat costs should be relatively low as the insects can generate significant heat (even though they are cold-blooded).

For large operations it is desirable that there is an area dedicated to the handling of the insects when they are removed from tanks, such as when they are transferred into clean tanks for starvation prior to culling (for human-edible crickets, see below). The insects are very active and many will be lost as they hop large distances and in temperate climates this problem can easily be solved by cooling the insects down to a temperature of around 10 °C to render them inactive. One cooled, the insects are much more easily handled.

Waste

For every kilogram (about 2500 large *A. domesticus*) of crickets produced approximately 1 kg of waste will be produced ("frass") if the colony is healthy. This material is known to be a good fertiliser and can be added to soil. Indeed, in the USA commercial cricket farms sell cricket frass to gardeners which indicates the value of the material. The harbourage may be reusable for several cycles of insect production but will inevitably degrade and spoil. Re-use of harbourage should not be undertaken where disease issues are suspected. if made of cardboard, the used harbourage can be burned, where permissible, or composted.

PROCESSING INSECTS (FOR HUMAN FOOD)

Crickets are becoming popular as a human food and, whether you have a few hundred insects or many millions, they need to be rendered clean and safe to eat. As such, when crickets are near mature (late stage nymphs) they need to be culled and processed. Typically, some insects will be culled every week. Prior to killing they need to be starved for at least 24 hours to allow the faeces in their guts to be excreted. To do this, the insects need to be placed in a clean container with no access to food with plenty of water provided. Insects can be killed by immersion in hot water after being rendered immobile through cooling to make handling easier.. A brief period of gentle boiling after killing serves to sterilize the insects and helps remove dirt adhering to their bodies. After boiling for a few minutes and thoroughly rinsing in cold fresh water the insects can then be used as whole insects immediately, frozen or dried. Crickets can be dried in a number of ways, such as in an oven or desiccators. Crickets are about 25% dry matter and as a result 1 kg of fresh crickets will be reduced to 250g. How you choose to dry the insects will affect how they taste. Gentle desiccation at around 70°C essentially removes water without cooking the insects whilst heating at higher temperatures, which is much faster, essentially cooks the insects and changes their chemical composition. Each way works and results in a safe cricket so choose the method that is best for you

Dried crickets. These crickets have been dried in a domestic halogen oven for around an hour at around 150°C. They were dried to around 23% of their original weight (i.e. the insects were 77% water).

Insects need to have around 98% of their moisture removed in order to prevent microbial activity. Once dry, the crickets can be stored for several months and used whole as a food or feed. They can also be ground into a powder that can be added to other foods to increase their protein content cricket powder is around 60% protein.

Further details of insect processing can be found in at the Highfield Biological Consulting website.

WHAT DO CRICKETS EAT?

Crickets are highly omnivorous and will eat all sorts of vegetable material and, when times are hard, will even eat each other. The type of diet you choose really depends on what you have available and what you intend to do with you crickets. From kitchen waste, pet food to chicken feed and vegetables, there is a wide range of options available.

1. Simple cheap diet for small scale / home colonies

A dry diet of breakfast cereals can be made up from Weetabix (40%), oats (20%) and cornflakes (20%) that can be ground in a kitchen blender to a powder. To this can be added ground dried peas (15%) to increase the protein content and ground sunflower seeds (5%) to increase the oil content. If you want a higher protein content, you can reduce the cereal components somewhat and use dried milk instead. The ratio of materials is not too important but it helps to get everything well mixed. This diet can be augmented with a range of vegetable materials (see below) such as carrots and potato, lettuce and even fresh grass.

2. Gut loading diets

Where the crickets are being fed to reptiles the loading of the crickets with a range of minerals may essential for the pet in question. Commercially available gut-loading insect diets are available from pet stores that can be used for this purpose although though they are relatively expensive compared to the above diet and growth of the crickets will not be significantly increased.

3. Poultry / livestock feeds (large colonies)

In very large colonies where many kilos of feed will be required daily, it is often desirable to use a commercially available feedstuff. Poultry feeds are typically the most commonly used and contain around 20% protein. For very small crickets, the crumb formulations produced for small chicks are best but, as the crickets grow, bigger pellets will be readily eaten**.** Many chicken feeds have anti-microbial chemicals included in them to prevent the chickens becoming sick. If you are concerned by these materials and/or the presence of GM ingredients, purchase “organic” chicken feeds as these generally do not contain these components

As commercially produced compound feeds are relatively expensive, costs can be reduced somewhat by using other animal feeds as the crickets grow. Mixtures of micronized (dried/cooked) maize, peas and beans will be readily be eaten by larger crickets and, due to the size of the insects, these feeds do not have to be processed to any extent (moderate grinding will help, however) to render them acceptable to the crickets (although these diets are hard, the crickets will readily eat them). Micronized feeds can be readily bought from farm merchants etc.

A range of animal feeds (cattle, sheep etc) are all readily eaten by healthy crickets but it must be noted that, as these diets are tailored to ruminants, they contain a number of materials that are not necessary for insect growth and may potentially taint the insects 9i.e. ith heavy metals etc). Similarly, the addition of meat-containing pet foods, such as cat biscuits (preferably ground), can be used to increase the food value of the diet although we prefer to keep crickets vegetarian!

4. Vegetables

Crickets will eat all manner of vegetables. The major consideration is probably ease of use and any potential detrimental effects on the crickets and how they taste. Carrots and potatoes are excellent and last well after being given to the crickets. Moreover, in some case animal grade carrots and potatoes can be purchased that are much cheaper than those destined for the supermarket. Cutting them into small pieces or shredding improves uptake by the crickets, especially when they are small. Avoid cabbage and other brassicas as these often contain compounds that could impart a taste to the crickets and, in some cases, lead to them being avoided as a food. As a rule of thumb, just test what you have available and see whether the crickets thrive on it. Some vegetable rapidly decompose at the temperatures that crickets are reared at, as do some fruits, and as such, it is best seeing which is best for your circumstances n order to prevent your tanks becoming full of slimy vegetable material..

DISEASE PROBLEMS

There are a number of problems that can affect cricket colonies. By far the most serious is the outbreak of virus. A number of virus affect crickets but the most important is *Acheta domesticus* densovirus (AdDV). This virus only infects *A. domesticus* and has had serious impacts on cricket production across North America and Europe and is extremely hard to eliminate from a colony. The disease manifests itself as a slow dying-off of the crickets as they age, with affected insects becoming paralysed and dying a few days later. There are a number of other viruses that affect *A. domesticus* as well as other species of cricket, such as Cricket Paralysis Virus (CrPV) and an Iridovirus. If you see crickets like the those in the picture below, it is time to act as you will have virus in your colony

Virus symptoms. *Acheta domesticus* showing the classic signs of virus infection. These insects are alive and immobile. Symptoms generally show most noticeably in large nymphs and/or adults

Mortality reaches about 80% or higher with these viruses and adults that do survive are infected and, as a result, pass on the virus to the next generation. **Highfield Biological Consulting** have developed a protocol that has been demonstrated to successfully control the virus outbreaks in large cricket farms. Details of this protocol are available **on request**. Other viruses affect other cricket species and often significantly reduce productivity of the colony.

Another problem that can occur in cricket populations is the occurrence of mites. These tiny eight-legged arthropods may occur in millions and can look like dusts in the bottom of the tanks. Mites reduce the productivity of the colony, cause workers to feel itchy and, in some cases, cause allergic reactions. If you get mites, you need to get rid of them through doing the following:

- Reduce the humidity of the room - mites hate dry environments (<60% R.H.)
- Increase ventilation to tanks if possible
- Avoid food spillage and remove fresh foods (vegetables)
- Prevent leakage from the water drinker.
- Remove damp harbourage

FURTHER READING

There are lots of resources on cricket farming and many simply repeat the same information. Primary sources are best, such as the ones details here.

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DISCLAIMER

This methodology has been produced by Highfield Biological Consulting. The information presented here is based on the personal experience of the author and is believed to be accurate and effective. We do not take responsibility or liability for any issues that may ensue from the. use or misuse of the methodologies described. The eating of insects is now becoming common but readers are urged to remain cautious with respect to consuming insects in order to be sure that they have no allergy towards them.

Corrections, comments and inquiries are welcomed

Version 1. January 2019

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