

Establishment of A Viable Mass Production Unit For Bio-Control Agents

Arka Manna and Md Imraj Zaman*

Ph.D. Research Scholar, Dept. of Entomology, Bidhan Chandra Krishi
Viswavidyalaya, Nadia, West Bengal, 741252

ARTICLE ID: 27

Introduction

The ability to rear insects in large numbers successfully is the basic requisite for the effective implementation of biological control programmes. To produce good quality infrastructure facilities, trained manpower and standard operating procedures are essential. The biocontrol agents, a well-established laboratory with necessary insect rearing and biocontrol agent production facilities vary widely in type and operation methods. The activities carried out in the production facility involve,

- ✓ Regulation of environment,
- ✓ Handling of different life stages of insects,
- ✓ Sanitation in the workplace,
- ✓ Preparation of feed materials for the insects, and
- ✓ Preparation or processing of biocontrol agents.

Therefore, different kinds of equipment and rearing materials such as glassware, plastic ware, cages, storage racks, and chemicals are required for successful management in production. The choice of equipment will depend upon the categories of biocontrol agents produced. A general-purpose facility will need most of the materials and they can be used commonly for the majority of the biocontrol agents.

Scope

Though about 140 bio-pesticide production units are existing in the country today, they can meet the demand of only less than 1% of the cropped area. There exists a wide gap, which can only be bridged by setting up more and more units for the production of Bio-pesticides. There is a scope to enhance the production and use of biological control agents in the days to come as the demand is on the increase every year. This requires large-scale investment and private participation.

Location

To achieve optimum results, bio-pesticide facilities are to be set up in areas that have appropriate climatic conditions. Because temperature control is less costly in locations where there are no extreme conditions. Besides the climatic conditions, the proximity of the location to the market is also important. However, care must be taken that the production facilities are set up at least a quarter of a mile away from farming areas, to prevent the contamination of production facilities by insecticides from the farming areas. Also, as air pollution can damage bio-pesticides, the production should be located away from industrial and urban areas.

Objectives

- ✓ The primary objective of bio-pesticide projects is to establish the bankability of mass multiplication of various bio-agents.
- ✓ To serve as guideline assistance to entrepreneurs who may be interested in setting up bio-pesticide units.
- ✓ To promote the setting up of more bio-control production units.
- ✓ To disseminate widely the technology.

Type of facilities

Currently, the facilities in biocontrol agent's production are generally for Research and Development and Commercial Production. The former is aimed to explore and identify categories of biocontrol agents, study their biology, and effectiveness against crop pests, develop cost-effective methods of production, prescribe quality control parameters, and demonstrate the effectiveness of the agents under field conditions. A research and development center may have a commercial unit to supply the biocontrol agents in limited quantity to the farmers and to experiment on the commercial feasibility of the agents. The Tamil Nadu Agricultural University, Coimbatore, and the Project Directorate of Biological Control, Bangalore are working on several biocontrol agents on the above lines. The commercial production facility is aimed to make available the biocontrol agents in large numbers to the farmers with the object to make a profit with quality. A commercial facility may have an internal research and development unit to find out ways and means to solve immediate day-to-day problems and also to keep abreast of the changing needs of biocontrol agent production.



Depending upon the number of species of host insects reared and biocontrol agents produced the facilities are classified into two different types.

- ✓ **General purpose facility:** When many species of insects are reared for the production of different kinds of biocontrol agents and the facility concentrates on a very large clientele group then these facilities are called general purpose or multiple species facilities.
- ✓ **Specialized facility:** The numbers of biocontrol agents produced are narrowed down to a few categories but in large numbers. In this type, the clientele group services are also narrow.

A combination of procedures, equipment, and space environment decides the scale of production of various categories of biocontrol agents. It may be a Cottage facility wherein the produce with simple techniques produces biocontrol agents in limited numbers for own-farm use and supplied to a few needy groups. This facility depends extensively on either family or hired labor in the farmstead. On the other hand, an entrepreneur may produce biocontrol agents and market them locally or widely. Due to constraints in capital investment, lack of suitable market channels, and non-availability of professional input of techniques for scaling up production the entrepreneur attempts to produce less and caters to a limited clientele. The service area covered could be a few thousand acres only. The production centers of such types are called Pilot Scale Production Facilities. Wherever possible and required essentially, labour is substituted by machines in production. A pilot-scale production facility may not be dependent on machines in production. These units are called Traditional Pilot Scale Facilities. When they partially use machines in production the systems are called Semi-automated Pilot Scale Facilities. These types of systems function in a decentralized manner. Several such pilot-scale production centers are needed to supply biocontrol agents if large areas of crops are to be covered in any season. The ideal form of existence is the Industrial Production Facilities that are in a position to supply greater amounts of quality biocontrol agents and cover large acreage of crops. These systems have a very large clientele group and with an excellent network of the market, channels offer better services on the methodologies of how to use the biocontrol agents. These units effectively substitute automated methods in production and the dependence on labour is limited.

Design & space requirements

The broad objectives of the programme and the procedures involved are vital in designing a facility. However, sophisticated a facility is unless designed properly, there will not be consistency in production. Not all insect and their biocontrol agents require the same type of facility, equipment, and procedures. A compact facility may be sufficient to produce certain species of entomophagous like *Cryptolaemus montrouzieri*, or an elaborate structure is needed as in *Helicoverpa armigera*. Separate facilities are needed in entomopathogens multiplication. This is essentially required to prevent the contamination of host insects in the insect-rearing area with entomopathogens. Most structures currently available in India are designed originally for other purposes and do not meet the standard requirement. All the more, describing an ideal form of insectary or biocontrol agents production facility is difficult. The facilities have to be located well away from urban activities but easily accessible to the city, free from direct radiation, and with good drainage. The materials used in construction must provide permanence, clean ability, serviceability, economy, and safety. The interior walls must be of smooth finish preferably epoxy coated and fungus resistant. The floors in general have to be ceramic tiled to facilitate easy sanitation. In the critical areas, the walls should have a ceramic coat. The ceiling in rearing areas should be insulated with gypsum board. The entire area where insects are housed the doors, windows, and ventilators should be made insect-escape-proof.

Depending upon the business objective and capital investment, new facilities can be created or older structures modified. The size requirements depend upon the target of production. However old or new, the facilities should be designed or modified to meet the primary activities viz., maintenance of the different stages of the insects, and their biocontrol agent production. In addition, associated activities that are very vital for the maintenance of the culture viz., feed/diet preparation, water, and electricity supply, sanitation and facility maintenance, regulation of rearing environment, storage of rearing materials, drainage, and waste disposal have to be given importance in designing the facility.

A production complex may be divided into several sections viz., administration, quarantine, production, storage, wash and waste disposal. Areas, where different stages of insects are maintained, are often prone to contamination, and prevention of entry of pathogens and cent percent control in the event of contamination are very critical. Therefore, in the production facilities, it is ideal to separate these critical holding areas from the rest.

Moreover, if these holding areas are further subdivided into separate cubicles, the possibilities of human traffic and entry of pathogens are greatly reduced. This holds good when different strains of species of parasitoids or predators are maintained in the laboratory. E.g., *Trichogramma chilonis* and *T. japonicum* have to be maintained in separate enclosures or holding rooms if the purity of the product is to be maintained.

Equipments & materials

➤ Quarantine area: -

Whenever new specimens of insects or their biocontrol agents are brought to the laboratory, either from the field or from another laboratory, the specimens should not be moved to the production area without examination for the presence of biological contaminants. Therefore, the specimens have to be kept in a quarantine area, which requires the following.

- ✓ Table or bench
- ✓ Large sink with running water and draining racks
- ✓ Drain with soil trap
- ✓ Tools for cutting (saw, axe, secateurs, chisel, and stout knife)
- ✓ Buckets, sieves, plastic trays, plastic containers of different sizes
- ✓ Bags (thick paper and plastic), specimen tubes, or similar containers
- ✓ A hand lens, scalpel, forceps, and writing/marketing materials.
- ✓ Microscopes for preliminary diagnosis



Mass production laboratory

➤ Main Laboratory

The basic requisites in the laboratory are furniture including a well-laminated bench, drawers, cupboards, and shelves. The number and size depending upon the target of the biocontrol agents to be produced. A continuous electric power supply (mains or generator) is essential for the smooth running of equipment.

➤ **Large items of equipment**

- ✓ Refrigerator, preferably with a separate freezing compartment or a separate freezer.
- ✓ Incubator – for culture growth.
- ✓ Water deionizer or still – supply of pure water.
- ✓ Hot air oven
- ✓ Gas stove
- ✓ Autoclave – a large domestic pressure cooker or industrial type.
- ✓ ‘Top pan’ balance – 0.05 – 500 g – for weighing chemicals and media
- ✓ A pH meter for checking the pH of media.
- ✓ Microbiological safety cabinet or Laminar flow chamber.
- ✓ Stereoscopic (Low-power–x20–200) dissecting microscope for examination of specimens and culture.
- ✓ Research (high-power–x100–1000) microscope for pathogen identification and some tissue examination procedures.
- ✓ Vacuum cleaner for regular cleaning of the laboratory.
- ✓ Personal Computer with printer, uninterrupted power supply system, and voltage stabilizers for equipment.

➤ **Instruments**

- ✓ Standard dissecting instruments such as forceps, scalpels, scissors, and mounted needles are required in both fine and coarse sizes.
- ✓ Holders and wire for inoculating loops are required for subculturing.
- ✓ Tripod and gauze, spirit/gas burner, saucepans, dishes, draining racks, buckets preferably plastic.

➤ **Glassware**

- ✓ Beakers 10, 25, 100, 250, and 1000 ml.
- ✓ Erlenmeyer flasks (conical flasks) 250, 500 ml.
- ✓ Desiccators.

- ✓ Measuring cylinders 10, 25, 100, 250, and 1000 ml.
- ✓ Pipettes 2, 5, and 10 ml graduated (with rubber filler)
- ✓ Petri dishes 5, 9 cm diameter (glass and/or plastic)
- ✓ Watch glasses or embryo dishes.
- ✓ Medical flats (Medicine bottles), amber glass, wide neck, 300 ml (do not fill more than two-thirds full) for storing made-up culture media
- ✓ Screw cap bottles, universal style with wide neck, 25 ml sizes (glass or plastic) for cultures, specimens, etc.
- ✓ 'Plain cap', wide neck, bottles 10, 20 ml for holding or treating specimens.
- ✓ Large test tubes for heating specimens.
- ✓ Microscope slides.
- ✓ Coverslips.
- ✓ Dropping bottles, and amber glass, for holding stains.
- ✓ Reagent bottles, amber glass, various sizes.
- ✓ Boxes, clear plastic, for incubating specimens.
- ✓ Bottles, various sizes.
- ✓ Bags, various sizes, paper, and plastic.
- ✓ Trays.
- ✓ Sieves, brushes, and strainers.

In addition to the above items, specific items are required in the production of various biocontrol agents.

- ✓ Adult emergence cages of different sizes to handle the adults of lepidopterans viz., *Helicoverpa armigera*, *Spodoptera litura*, *Plutella xylostella*, *Corcyra cephalonica*, and in mass production of *Cryptolaemus montrouzieri*.
- ✓ Plastic basins for the production of *Corcyra cephalonica*.
- ✓ Open storage racks for *Corcyra cephalonica*.
- ✓ Oviposition chambers for *Corcyra cephalonica*.
- ✓ Moth collector and scale separator for *Corcyra cephalonica*.
- ✓ UV Chamber for sterilizing the eggs.
- ✓ Domestic mixer for preparation of semisynthetic diet.
- ✓ Pipetting systems for the preparation of viral suspensions.

- ✓ Centrifuge for processing the viruses.
- ✓ Haemocytometers for counting and standardization of virus.
- ✓ Storage bins, dust bin-type buckets, etc.
- ✓ Air conditioners.
- ✓ Humidifiers/air coolers.
- ✓ Safety equipment like fire extinguishers.
- ✓ First aid box.

Placement of equipment in the laboratory

The equipment, instruments, and miscellaneous items have to be placed where potential hazards for the workers are non-existent. Heat-generating equipment like autoclave, hot air oven, etc., should be placed in sterilizing zones with good ventilation and should not be placed near the culture rooms. Temperature and humidity controllers should be used in culture areas. Laminar Flow Chambers should be placed in culture rooms or inoculating rooms. Diet preparation equipment etc. should be placed separately in proximity to the larval culture area.

Chemicals

The following are some general reagents needed for several routine operations in the Biocontrol Laboratory.

- ✓ Distilled or deionized water – cleaning, preparation of other reagents and media.
- ✓ Industrial alcohol or methylated spirit – cleaning, surface sterilizing.
- ✓ Sodium hypochlorite solution – for surface sterilizing. A 10% dilution of fresh commercial bleaching solution is suitable but must be kept cool, in a dark bottle and replaced regularly.
- ✓ Formaldehyde (commercial grade) for critical sterilization.
- ✓ Potassium permanganate for fumigation in the laboratory.

Care is needed when handling or using reagents of all kinds and brief details of the substances referred to in the text are given in the section on Handling Notes on the labels.

Operation of equipment

Types of equipment used in the Biocontrol Laboratory serve a distinct purpose. The pieces of equipment are either purchased from manufacturers or fabricated to suit the requirement. Acquaintance with the functioning of the machine is the primary need before



operating them as the equipments are costly. Each of the equipment used in the laboratory is provided with instruction manuals for operation. The manuals have to be consulted for trouble-free operation of the equipments and maintenance.

