United-Tech, Inc./ Bio-Form LLC Technical Bulletin

Biosecurity for Aquaculture Facilities

Biosecurity is the protection of living organisms by the Exclusion of Pathogens and Other Undesirables. Thus, biosecurity in aquaculture is the protection of fish or shellfish from infections (viral, bacterial, fungal, or parasitic) agents. Designing an effective biosecurity program requires an understanding of the aquaculture operation, general principles of disease transmission, and knowledge of the fish or shellfish maintained in the facility.

Aquaculture is one of the fastest growing industries with an annual growth rate of > 11 % for the past 10 years. Mortality due to diseases or decreased growth rates and/or decreased feed efficiency due to infections are major factors for economic loss in aquaculture. In addition, as the density of fish or shellfish in an intensive aquaculture facility becomes more concentrated, the probability of individuals coming into contact with a potential pathogen becomes greater. Thus, safeguards to protect the health of both fish and shellfish in an aquaculture facility become very important. While aquaculture has made rapid advances in the past few years in fish and shellfish diagnostics, disease prevention and disease control measures lag significantly behind. Therefore, it is imperative to develop and enforce Ecologically Sustainable Development (ESD) strategies to meet the needs of the present without compromising the ability of the future generations to meet their own needs.

Biosecurity in Shrimp farming:

Encompasses issues ranging in scope from global, national, watershed, facility, tank and finally to organism level. At the shrimp farm level, biosecurity refers to producing healthy shrimp in a well-controlled environment that excludes the introduction or propagation of unwanted organisms and includes the prevention or escape of organisms back into the natural environment. The primary goal of a biosecurity program in shrimp farming is to prevent the introduction of any infectious organism into a shrimp farming system. Since this is not always possible, the goal may have to be modified to prevent, eliminate or control infectious diseases within the facility.

There are numerous potential sources of entry for an infectious agent into an aquaculture facility. These include additions of new stock (fry, post larvae, juvenile shrimp and broodstock); contaminated water or feed, humans, animals or equipment, and subclinical (asymptomatic) carriers within the existing stock (production shrimp or broodstock). Each of these potential sources needs to be evaluated and continuously monitored to prevent the entry of infectious organisms into the system. Thus, a sound biosecurity program for a shrimp farming facility would incorporate a) disease prevention b) disease monitoring, c) effectively managing disease outbreaks, d) cleaning and disinfection between production cycles, and e) general security precautions.

Biosecurity measures to prevent diseases:

Disease prevention includes the methods used to prevent the entrance of all potential pathogens into the aquaculture facility. One of the principle methods to avoid the introduction of certain pathogens into an aquaculture facility is to purchase shrimp/post larvae from a producer selling certified specific pathogen-free (SPR) stock. Though this does not eliminate all potential pathogens within the supply, it does help reduce the risk on introducing the major pathogens of shrimp. Unfortunately, only a few species of shrimp are presently sold in this manner. Thus, many producers have established in house brood stock or spawning facilities to provide stock for production facilities. In addition to disease avoidance, a rigid quarantine program should be incorporated to isolate any new arrivals at a facility. The time interval required for a quarantine period can vary but will generally take between 45-60 days. During this time, the shrimp can be closely monitored for clinical signs of disease, sampled for diagnostic health techniques, and treated if warranted. Vaccination is another means of disease prevention in aquaculture.

Another important method of disease prevention includes providing a pathogen-free water source. Thus, an “infected” water supply may require modern technology (mechanical filtration, chemical treatment, UV filtration, ozonation, biological treatment with probiotics etc) to make the water acceptable for a biosecure facility. Finally, optimal management techniques, including stocking densities, nutrition, and genetics are essential for all aquacultured species to develop and maintain an optimal health and immunological status to fend off any potential pathogens.

Disease monitoring should be an essential part of any biosecurity program. This consists of regularly scheduled health evaluations of all stock in an aquaculture facility. Depending on the particular situation, this may include either lethal or non-lethal sampling or both. Non-lethal techniques may include gill, shell and immunological assays, while lethal sampling may include bacterial cultures, viral isolation and histopathology. Though none of these assays can completely guarantee that there are no potential pathogens in a shrimp population, they do help reduce the risk of maintaining a pathogen in a population. An initial or pre-purchase health evaluation of new stock will establish baseline information about the shrimp, and can provide valuable information if a disease occurs in a facility. Periodic monitoring can also help determine the number of individuals within a population that are infected, and the level or intensity of infection within that population.

An important area of disease prevention and control that is often overlooked in the aquaculture industry is disinfection. Routine disinfection is used to reduce the pathogen load in a facility, thereby reducing the risk of spreading an infectious organism between groups of shrimp in a single facility. For example, providing an adequate number of containers of appropriate disinfectant for nets and other shared equipment is one method used to inactivate potential pathogenic organism. However, having separate equipment (nets, feed buckets, water sampling jars, etc.) for each production unit would be optimal in helping to eliminate the risk of contamination between production systems. Disinfecting live-haul vehicles after delivery of stock to farms or other facilities also

helps to avoid bringing back a potential pathogen from these others sites. In addition, cleaning and disinfection of the aquaculture facility and associated equipment between production cycles is very important and helps reduce the risk of spreading an infectious agent from one production group to the next.

Good Aquaculture Practices (GAP)

Aquaculture exports in general are looked upon as potential carriers of harmful chemicals, antibiotics and bacteria by major exporting countries. Therefore, the exporters are continually swamped by new requirements related to labeling, traceability, bio-terrorism, assurance of product safety, risk assessment etc. This has lead to the creation of GAP which is tremendously focused on pre-harvest phase for improved production, food safety assurance and preservation of environments. Emphasize has been placed on farming practices like pond preparation, disinfection of water, aeration, temperature, pH, alkalinity, salinity, feeding issues, sludge reduction, lowering water exchange, removal of nitrogenous compounds, use of antibiotics, use of probiotics and so on.

HACCP in Aquaculture

Based on the heightened expectations and enthusiasm of the shrimp industry in the producing countries, it is believed that GAP alone will not be adequate but by the implementation of HACCP in aquaculture. This integrated approach primarily for food safety also provides adequate focus on the pre-harvest phase for safe, profitable and sustainable shrimp farming. Under the HACCP program implementation, critical control points are determined and corrective steps are taken before it becomes a hazard. Routine screening of shrimp samples using PCR (polymerase chain reaction) technology has come to play an important role in managing viral diseases in shrimp culture.

Microbes for Sound Aquaculture Production Systems: Probiotics

It has been suspected for quite some time that microorganisms play important roles in overall aquaculture practices. Positive aspects of microbes include their potential to provide additional nutrients thereby reducing feed costs, and their role in maintaining desired conditions within the culture environment. On the other hand, microbes may cause significant losses to operations if they are pathogenic. Efforts to compile the disparate but relevant facts about the use of microbes in aquaculture have been limited until now. Recent studies indicate the use of microbes as probiotics in culture systems for stability and control of microbial populations, maintain stable water quality parameters, eliminate the presence of stressors like NH3, NO2, NO3 etc, prevent bacterial infections caused by Vibrio and other Eubacterial pathogens, Viral infections etc. An increasing body of research indicates that selected microorganisms like Yeasts (Saccharomyces

cerevisiae, Candida utilis, Kluyveromyces marxianus) and yeast products offer several benefits: improving feed attractability, supporting growth by producing vitamins, minerals, nucleic acids and by stimulation of beneficial gut flora. In addition, the immunostimulatory property of yeast cell walls (beta glucans and mannans) to induce short-term non-specific immune response in shrimp is very beneficial to survive in the overwhelming presence of bacterial and viral pathogens. Live yeast can function as probiotics adhering to and colonizing the intestinal mucus, eviction of pathogens out of the hepatopancreatic system, produce critical nutrients that can impact growth like vitamins, minerals, and polyamines involved in many biological processes. BZT® Waste Digester and BZT® Aquaculture both include not only beneficial bacteria and enzymes, but also beneficial yeast.

Finally, general security precautions need to be established from each facility to help support the activities of both disease prevention and disease control. A manual of standard operating procedures (SOP) should be assembled to provide a set of standard rules for biosecurity measures and disease monitoring. This should include such things as facility design, facility flow for both personnel and stock, rules for limited or restricted access to facility, required visitor log book, disinfection procedures for both personnel and equipment, a waste management plan, pest control guidelines, and general husbandry and management procedures. This manual should also incorporate procedures to be instituted if a disease is detected or an outbreak occurs. Record keeping is paramount to the success of any biosecurity program because it can provide accurate historical information about the health status, weight gains, feed consumption, vaccinations or treatments, and management practices of the facility.

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