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Lecture Notes

Part 2

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RELEVANCE OF DISEASE MANAGEMENT WITH SPECIAL REFERENCE TO SUSTAINABLE FISHERIES AND MARICULTURE

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Introduction

When the ability of the traditional food production systems such as a agriculture and animal husbandry has shown stagnation in the new millennium, India need to find alternative food production systems to feed the ever growing population. In this endeavour 'aqua farming' on land and farming in sea is to play a major role, considering vast potential of water bodies and seas of India, where fish farming can be practised. It is estimated that about 5 million tonnes of aquatic animal products can be produced annually through land based aquaculture in India, and the potential of seafarming could be many fold.

The growth and economic viability of the aquafarming primarily depend on the successful prevention or control of disease outbreaks. Unlike the land based farming, the disease problems in aquafarming are complicated due to the three-dimensional nature of culture system where the dynamic interaction of biotic fauna comprising the host and opportunistic pathogens and abiotic factors exists. The coexistence of host, and pathogen in an aqufarming environment makes it all the more difficult to control/treat the disease. Disease prevention in aquaculture is not merely a case of dealing with the pathogen and its elimination, but it has to be dealt with a broader perspective, which is now popularly termed as Aquaculture Health Management.

Disease problems were not a major deterrent when the aquaculture activities were extensive in nature, as in the case of traditional shrimp culture operations of Kerala, Goa and West Bengal. Intensive systems lead to higher stocking densities and increasing stress. When animals become stressed, disease outbreaks often occur. Creation of intensive rearing systems aiming for more and more production and profits, without proper planning and management, invite problems of infection and disease.

Unlike the land-based animal rearing systems, where the diseased animals can be identified and treated individually, the scope for disease control in aquaculture through detection and treatment is only of limited value, mainly due to the coexistence of the pathogen in the aquatic rearing system. The fish is constantly bathed in potential pathogens, viz., parasites, bacteria, fungi and viruses. Separating the infected or diseased animals from the population and subjecting them for a treatment regime is impractical, if at all possible, it is not an economically viable measure. Hence disease treatment becomes a difficult proposition in aquaculture, and disease prevention is a natural choice. The management practices that are designed to prevent the occurrence of disease in a fish grow out system is termed as the Aquaculture Health Management. It is a holistic approach where disease monitoring or pathogen watch, fish quarantine, SPF (specific pathogen fee) selection, animal nutrition, environmental health and HACCP (hazard analysis and critical control point) principles are integrated.

Aquaculture Health Management

Aquaculture health management primarily constitutes two aspects, namely, farm health management and fish health management. Successful integration of these two factors only can deliver a disease free environment.

Farm health management constitutes

- maintenance of good soil quality
- maintenance of good water quality

- maintenance of good farm productivity
- good feed management and
- maintenance of proper farm quarantine to prevent horizontal transmission of disease causing pathogens

Fish health management constitutes

- Proper animal quarantine
- Screening of broodstock and larvae/fingerlings
- Crop health monitoring and pathogen watch

Effective implementation of all the three aspects of fish health management depends entirely on the early and accurate diagnosis of the disease causing agents. Failure of accurate diagnosis of pathogens can lead to faulty treatment resulting in multiple problems like indiscriminate use of chemicals and drugs, drug resistance, large-scale mortality causing crop failure and economic loss. The occurrence of disease can be prevented by detection and avoidance of the pathogen. Timely and early use of proper diagnostics can be used as an effective tool of health care management.

Disease diagnostics in aquaculture

The different types of diagnostic methods used in aquaculture are

History

History of disease at facility or in region, farm design, source of seed stock, type of feed used, environmental condition.

Required resource: Systematic record keeping.

Nature of diagnosis: Primary, inconclusive.

Behaviour

Movement pattern, feeding pattern, mortality.

Required resource: Experienced farm technicians.

Nature of diagnosis: Primary, inconclusive.

Gross, clinical signs

Physical clues like lesions, haemorrhage, colour changes, fouling

Required resource: Experienced farm technicians

Nature of diagnosis: Primary, inconclusive.

Direct microscopy

Bright-field, phase contrast or dark field microscopic observation on wet mounts, stained or unstained tissue of abnormal or diseased animals.

Required resource: Experienced farm/laboratory technicians.

Nature of diagnosis: Primary, inconclusive.

Histology and histopatholgy

Routine histological and histochemical examination of tissue sections.

Required resource: Laboratory facilities and experienced laboratory technicians.

Nature of diagnosis: Secondary. Method provides specific information but poor in sensitivity and speed.

Electron microscopy

Ultrastructural examination of infected tissue sections, negatively stained virus preparations or surface scanning of samples.

Required resource: Expensive laboratories and expertise.

Nature of diagnosis: Conclusive, method is time consuming and laborious.

Culture and biochemical identification

Standard culture methods of bacteria and fungi using selected artificial media preparations followed by biochemical tests.

Required resource: Good laboratories and expertise.

Nature of diagnosis: Conclusive. But the method is slow, and time consuming

Bioassay

Laboratory challenge of the candidate species with selected pathogen.

Required resource: Wet laboratory and expertise.

Nature of diagnosis: conclusive, slow and time consuming.

Serological Methods

Use of specific antibodies as diagnostic reagents in immunoblot, agglutination, diffusion, hybridisation etc.

Required resource: Good laboratories and expertise

Nature of diagnosis: Conclusive, different levels of sensitivity.

Tissue culture

In vitro culture of pathogens in tissue culture systems, or in primary cell cultures.

Required resource: Sophisticated laboratories with expertise.

Nature of diagnosis: Conclusive.

PCR, gene probes and DNA chips

Amplification and detection of unique sections of pathogen' s genome.

Required resource: Sophisticated laboratories and expertise.

Nature of diagnosis: Specific, most sensitive, and conclusive.

Diagnostic procedure

Disease is an abnormal condition characterized by a gradual degeneration of fish's/shellfish's ability to maintain normal physiological state because various factors adversely affecting its well-being.

The incidence of disease occurs in,

- Aquaculture facilities where fishes and shell fishes are commercially reared
- Ornamental fish rearing systems
- Game fishes in captivity
- Wild fishes

Once the infection or disease is suspected, the next step is to draw a diagnostic procedure, to fix the root cause of the problem. The diagnostic procedure may include a single diagnostic test or a combination of tests. In the case of routine pathogen watch or health monitoring, a set of selected diagnostic tests are performed to cover the potential pathogens. The approach generally followed is location specific and problem specific, where the first consideration is the availability of the diagnostic facility and expertise. There is no hard and fast method which can be applied for all cases.

A general approach in disease diagnosis is given below**:**

Records/History

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Observation of live/sick fish and Bacteriological/fungal, blood sampling, and EM sampling

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Gross external examination, tissue smears and ectoparasites

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Post mortem examination and sampling for histopathology/virology

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Water source and pond

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water/soil/benthos and plankton samples

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Laboratory analysis

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Parasitolgy

Histopatholgy

Serolgy

PCR/DNA Probes

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DIAGNOSIS

Once the right diagnostic picture along with the water and soil parameters are available, the health management measures with respect to causative factor, can be initiated. However, the diagnosis often gets complicated in the cases of mixed infections, with the involvement of primary, secondary and even tertiary pathogens.

The genesis of disease in aquaculture

In an aquaculture pond the health status of the animal can become weak due to different stress factors such as

- chemical stressors
- biological stressors
- physical stressors
- procedural stressors

In such situation the opportunistic pathogens such as parasites, bacteria, fungi, and virus surrounding the animal invades the animal body, resulting an infection. All infection need not result in disease manifestation. Only when the pathogen build up disrupts the threshold of animal resistance, the animal succumbs to disease condition. The situation is a complex one where different factors such as the environment, the animal and the pathogen interacts continuously, making health management a difficult proposition.

This can be further complicated with the involvement of more than one pathogen resulting in a mixed infection. A mixed infection can lead to faulty diagnosis. This spells the need of an integrated management approach to tackle the disease problems with respect to the animal, environment and pathogen using diagnostic a functional tool.

The integrated approach using diagnostics with farm management, can avoid the introduction of the virus via vertical and horizontal route, there by preventing the viral disease problem. The success of this approach mostly depends on the right choice and use of diagnostics along with other farm management measures, to keep both the animal and its environment in a healthy condition.

Individual health management models with a broader management approaches to control farm level environmental deterioration and preventive measures against pathogen introduction, depending on the availability of sensitive and specific diagnostics can be adopted for specific diseases caused by the pathogens such as bacteria, parasites, fungi, considering the economic aspects.

Suggested reading

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