Why controlling WSSV is so difficult?

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Anybody who has had WSSV affect farmed shrimp knows that this virus when it first appears can wipe a farm out in days. The shrimp can appear healthy, still be taking feed and within three days all die. Subsequent outbreaks tend not to be as serious in terms of overall mortalities but this is of little consequence when shrimp still die in large numbers at any size. What can a farmer do? First some background information.

1. Bear in mind that cultural conditions in the farm (as are most agricultural practices) are "unnatural".

In the wild, shrimp do not grow in ponds in large numbers at high densities consuming pelleted feeds.They have the luxury of spreading themselves out a very low relative densities. Interestingly enough WSSV is often much less of an issue when shrimp are stocked in ponds at very low densities regardless of other biosecurity measures. Cultural conditions are stressful by their very nature and often conducive to the development of very high levels of viral particles in the water and weakened affected animals that are readily consumed by their stronger brethren.

2. The virus is known to occur in many different vectors.

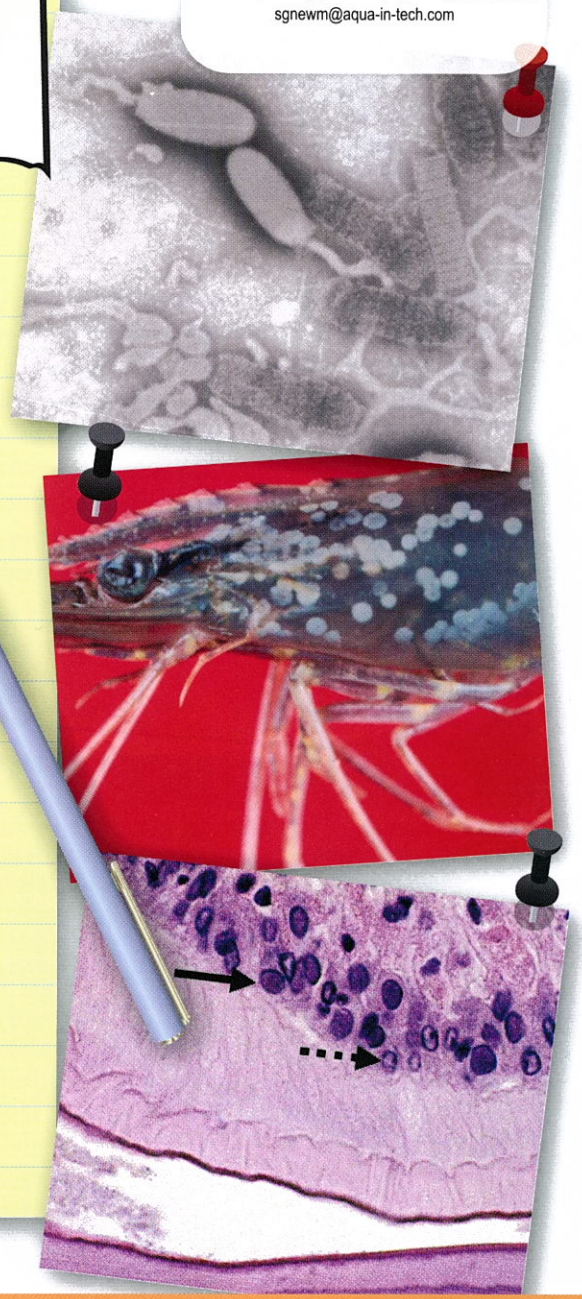
Dozens to hundreds. Vectors can be animals in which the virus replicates but not in a manner that kills them. They shed virus into the environment. Other vectors die much as the shrimp do (such as some crab species and other species of shrimp). These weakened and dying animals are eaten by vectors and shrimp, readily infecting them.

3. The virus is genetically plastic.

This means that in any outbreak there may be many different genetic variants of the virus potentially with different abilities to infect and produce disease. There is a strong selection pressure against viruses that kill their hosts too quickly. This is a well-recognized principle and has been observed with many different pathogens. When a pathogen is too virulent, it tends to kill itself off. The best long-term strategy for survival is not too kill the host.

4. Shrimp farming while it may appear to be simple is actually not.

Shrimp are susceptible to many possible pathogens, especially when they are stressed and while WSSV can be a killer it can also act in concert with other bacterial, fungal, protozoan and viral pathogens and likely some toxins to kill shrimp.



With these facts in mind a number of strategies have been developed which form the basis of standard biosecurity protocols on farm sites to try and mitigate the impact of the virus. These include, but are not limited to:

1. Water disinfection protocols

Prior to the use of water in the ponds the water is treated with chemicals (typically disinfectants or pesticides) to kill any possible virus in the water as well as vectors.

2. Crab fences

The movement of potentially infected crabs between ponds is prevented by the use of barriers that prevent ready movement between ponds.

3. Specific Pathogen Free (SPF) animals

SPF animals do not carry the virus into the ponds. They are not the source of the virus.

4. Standard physical barrier approaches

This can include things such as disinfecting vehicles tires that move onto a facility. Typically they might also limit movement of non-disinfected tools such as nets, boats, etc. between ponds.

5. Bird netting

Birds can readily move infected animals between ponds by gorging on dying shrimp and regurgitating them when they move to another pond.

This is only a partial list but encompasses some of the major steps typically taken. The question then is why don't these procedures always work? Why do animals still get infected?

It is my belief that there are three primary reasons for this.

1. The first is that the disinfection protocols employed simply are inadequate. Chlorine is the most common disinfectant of water that is used. Failure to appreciate that chlorine reacts readily with organic material lessening its effectiveness is one component of its problematic use. Using it in a non-lined pond may be effective in killing virus in the water but this viral reservoir is not probably the largest threat. Using it in a lined pond may be more effective but the reality is that many lined ponds may have damaged liners and that water diffuses underneath the liner acting as a more or less permanent reservoir for some potential vectors. There are several pesticides that are widely used as well purportedly to kill the vectors off. While they may be effective in lowering the overall level of vectors they do not apparently kill those forms (spores) of the vectors that are present in the pond sediments and even likely in the water. The proof of this is apparent in studies that have shown that post treatment PCR reactive material may no longer be present but that within days to a few weeks this changes and PCR reactive material abounds. Some of this could be explained by other mechanisms but not all.

2. SPF animals are not really SPF. There are strict protocols that must be followed to generate SPF animals, which involve quarantine for more than one production cycle and critical examination of the broodstock. There is evidence that WSSV can go dormant in an animal and that animal that carries the virus may be PCR negative and yet at some point in time becomes positive. As soon as PLs are produced in open systems they are potentially exposed to the virus. Screening PLs is a numbers game and it is possible to have a very low level of infection without even a dozen PCR tests detecting it.

3. Dogma preached by salesmen and others that products that are being sold in the market place with purported (or even real) anti-viral activity will kill off the virus. Some natural materials are widely used for this purpose often at the expense of the development of a meaningful and reality based biosecurity program.

It is beyond the scope of an article of this nature to be able to provide an in-depth examination of all of these factors and all of the vast amount of information that has been published on this extremely well studied virus. So what can a farmer do?

1. Make sure that your PL provider is using truly SPF broodstock. These are animals that are produced in closed systems indoors preferably in an area where there are no farms nearby. Biosecurity protocols in the hatchery must be consistent with this and the hatchery should destroy animals that are ill rather than consolidating low survival tanks.

2. Develop alternative environmental disinfection protocols. Recognize that there may be specific attributes of your production system that require the use of protocols that are not consistent with the standard protocols. This could include removal of topsoil from pond bottoms, filling ponds partially post drying and using very high levels of disinfectants, draining the ponds and repeating the process. This allows one to use better possible disinfectants at higher levels and lower costs. For lined ponds, fix the leaks every cycle.

3. Recognize that limiting viral loads is critical. The virus can mutate to becoming less virulent and this may be a reason why there typically are lower levels of specific mortality to WSSV over the course of repeated production cycles.

4. Stop looking for magic bullets. While I would never rule out the possibility that some tools are useful, such as those that act in concert with other biosecurity measures to lessen overall environmental viral loads, there is little (if any) peer reviewed data that demonstrates a reproducible impact on the disease process in the field. Lab studies must show efficacy but they rarely translate into a similar effect in the field. The field is not an aquarium kept at a constant temperature indoors in a stress free environment. Anecdotal field trial results rarely tell the whole story.

5. Consider poly-culture with fish that will eat dying animals keeping other shrimp from eating them.

6. Stock at densities that are more consistent with your ability to control overall viral loads. You might be better off stocking fewer animals, getting higher survivals of very large shrimp then repeatedly trying to out maneuver the virus.