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Building a better shrimp nursery, part 3

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Feeds and feed management, compensatory gain and perspectives

Nursery systems produce shrimp juveniles that are stronger, grow faster and typically have better FCR and survival rates, as well as significant potential for compensatory growth.

The importance of the successful use of hyper-intensive nursery systems in shrimp culture has increased significantly in recent years. Proper design and management of this type of system has shown to greatly increase profitability while reducing risk at the grow-out farm. For these systems, there are some general considerations for feed type selection and management. It is very common that the importance of this phase of operations is underestimated. Feeds and feeding drives this system and are fundamental to animal performance requirements or standards and are the primary contributor to declining water quality.

Current feed management practices in shrimp nursery systems varies greatly from producer to producer, and practices typically originated from traditional procedures modified through personal experiences and preferences. The major considerations to optimize performance of a diet are feed type, size, formulation and animal behavior and physiology. Other major considerations in feeding depend on water exchange capacity and ammonia management with autotrophic, heterotrophic or mixed systems.

Regarding feed formulation, there are special formulas required for nursery systems. Many commercial pond feeds are often nutritionally inadequate, have lower hydro-stability (and may impact water quality) and require higher feeding rates to satisfy the nutritional requirements of cultured shrimp. Manufactured aquafeeds should supply 100 percent of the nutritional requirements with a concentrated balance of essential nutrients. They should be highly palatable and digestible and minimize negative effects on culture water quality.

These feeds must also be formulated to support shrimp health and their immune system, and aid in stress management during the nursery phase and eventual animal transfer to grow-out ponds. Because of the high feeding rates and reduced water exchange typically used in heterotrophic systems, special consideration must be given to promoting a proper C:N ratio to support maximal assimilation of ammonia into the bacterial floc.

Shrimp nursery feeds come in many shapes and sizes to maximize consumption and nutrient uptake.

Regarding manufactured feeds for shrimp nursery systems, animal size and size distribution is an important consideration in selecting feed particle size to be fed. There are specific feed sizes and shapes that are optimal for various animal sizes. Using the appropriate feed particle size – which is age/size-specific – is very important. Table 1 shows an example of our company's feeding program for various stages, animal weights and production biomass.

If there are cultured animals of significantly different sizes within a tank, then feed particles of various sizes must be used. It is important to check feed container labels for manufacture dates, to insure feed freshness. Appropriate packaging is essential to maintain feed quality and nitrogen packaging is recommended to extend feed shelf life and palatability. Nursery feeds must be manufactured to have a balance between adequate water stability and nutrient retention, attractability and digestibility.

Prod. Stage	Animal Weight	Option 1: Hyper-Intensive Recommended for high biomass conditions			Option 2: Traditional Recommended for low-to-medium biomass conditions		
		Product	Protein/Fat	Particle Size	Product	Protein/Fat	Particle Size
1	2-10 mg	EZ Artemia	52-17*	0.3-0.5 mm	EZ Artemia	52-17*	0.3-0.5 mm
1	2-10 mg	PL Raceway Plus w/ Vpak	50-15	0.4-0.6 mm	PL Raceway 40-9 w/ Vpak	40-9	0.4-0.6 mm
2	10-100 mg	PL Raceway Plus w/ Vpak	50-15	0.6-0.85 mm	PL Raceway 40-9 w/ Vpak	40-9	0.6-0.85 mm
3	100-400 mg	PL Raceway Plus w/ Vpak	50-15	0.85-1.2 mm	PL Raceway 40-9 w/ Vpak	40-9	0.85-1.2 mm
4	400 - 1.5 g	PL Raceway 40-9 w/ Vpak	40-9	1.5 mm	PL Raceway 40-9 w/ Vpak	40-9	1.5 mm
5	1.5-3.0 g	PL Raceway 40-9 w/ Vpak	40-9	2.0 mm	PL Raceway 40-9 w/ Vpak	40-9	2.0 mm

*Dry Weight

Table 1. ZBI feeding program (Precision Feeding Program; PFPTM), for various stages, animal weights and production biomass.

Nursery feed management

The goal in nursery feed management is to apply sufficient amounts in a timely manner to achieve the desired growth objective. This involves the accurate prediction of daily feed conversion rates (FCR) and regular assessments of animal size and weight gains. Feed tables must be adjusted based on nursery water temperature; for example, if lower than 30 degrees-C, rations are reduced by 5 percent for each degree; and if over 30 degrees-C, rates are increased by 5 percent up to 34 degrees-C. Both over- and underfeeding must be avoided, as they affect feed efficiency, animal growth and health, and the former also impacts water quality.

Feeds and feeding drive nursery systems. The nutritional value of aquafeeds begins to decline quickly after immersion, and can lose much of their value after only one hour in water. Continuous feeding via automatic or belt feeders is a recommended practice, because shrimp are constantly feeding or grazing, and at a minimum, feed should be applied once every two hours (12 times per day). Automated or belt feeders also reduce labor costs.

Equal quantities of feed are to be fed at each feeding interval over a daily basis. Constant daily feeding rates can also contribute significantly to stable water quality. Shrimp feeding rates tend to vary little in nursery systems if they are stable, but can vary greatly day-to-day depending on variables such as water temperature and dissolved oxygen levels, and the presence of disease.

Shrimp are constantly feeding or grazing, so continuous feeding using belt feeders such as this one is a recommended practice.

Applied feed should reach 70 to 80 percent of the nursery area within several minutes of each feeding. This can be achieved by proper placement of auto- or belt feeders, or by physically broadcasting the feed across the surface, or by allowing the water circulation (from aeration) to distribute it. Excessive buildup of feeds in localized areas like tank corners must be avoided, because this can promote low oxygen levels, or even anaerobic/anoxic conditions and produce harmful hydrogen sulfide. The goal is to feed the proper/optimal/precise quantity of feed to each shrimp where they can easily access it and promptly consume it.

It is critical to avoid over- or underfeeding in nursery systems. To avoid overfeeding, it is common to use feeding trays, to visually check water columns, tank or pond bottoms,

And to physically inspect animal guts for fullness as a response to feeding. This should be done 30 minutes before the next feeding. If excess feed is found on the feeding trays between feed applications, the quantity should be proportionally reduced. The opposite is done if no feed is found when the tray is checked.

As a rule of thumb, increase a little and decrease more. It is important to observe intestinal coloration in sampled animals, which can vary depending on what the animals are feeding on, aquafeed or organic matter, or other items. Continually monitor shrimp growth rates and performance to check if feeding rates are achieving the production goals.

Observing animal feeding behavior is also important to understand if feed is being applied correctly. Shrimp molting activity must also be monitored. The typical response to molting is to s control or reduces feeding amounts. However, lack of feed in the system will encourage cannibalism.

Finally, overfeeding can increase biofloc density and bacterial populations to undesirable levels, and can also increase requirements for probiotics, ammonia and nitrite production control, oxygen demand and CO_2 production.

Feeding trays are commonly used to avoid overfeeding in some shrimp nursery systems.

Compensatory growth opportunity

Many shrimp nursery systems, even when properly designed and managed, can have slower than optimum growth rates, and the animals may not reach the same size as those stocked directly into a pond at the same temperatures. This is partly due to stocking density, with 20-200 PL/m^2 in directly stocked growout ponds vs. > 5,000 PL/m^2 in nurseries (growth is density-dependent in marine shrimp). However, cultured shrimp, especially *P. vannamei*, have shown to be able to recover this growth difference in a very short time – due to compensatory gain. However, this can only be achieved effectively if animals are properly nourished with specialized feeds that satisfy their nutritional requirements, and also support overall animal health and disease resistance.

In addition, for compensatory growth to occur, farmers must adapt their pond feeding protocols after transferring the nursed juveniles to their grow-out ponds. Proactive pond feed management is required to quickly respond to animals' feeding responses. This is an important tool in pond management, to shorten time in grow-out ponds to market size, reduce disease risk and increase profitability.

Perspectives

Properly designed and operated shrimp nurseries are a valuable production tool that can provide proven benefits and allow for much more efficient use of the carrying capacity of ponds over direct stocking of PL. They can also help in managing various risks during the first 20-40 days of the production cycle, and because of the resulting, shorter pond grow-out times, the daily fixed costs are also reduced for each kg of shrimp produced.

The best economic gains resulting from using nurseries are where there is an opportunity to stock PL at a farm to reduce the total duration of a cycle to market size, or when seasonal temperatures are too cold for open pond stocking. Also, to have a large number of juveniles ready to stock when pond temperatures increase, or, in some regions, when regulations allow pond stocking.

Shrimp farmers can also reduce the time to harvest by having juveniles ready to re-stock a pond following a harvest, increasing the number of cycles per year or improving the size of shrimp at harvest. Another important benefit is when stocking ponds where primary productivity is typically low (such as when using oceanic water) and there is a need for juveniles large enough to go directly on to pelleted feeds. And nurseries can help manage various shrimp diseases, serving as on-site quarantine units.

Farmed shrimp producers are continually searching for improvements to reduce risk and increase efficiency and profitability, and the proper implementation of hyper–intensive nursery systems is a practical and cost-effective production improvement. Proper management of water quality (including biofloc technology, if used) and aquafeed inputs in shrimp nursery systems is critical and can enhance overall profitability.

Now that you've finished reading the article ...

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Shrimp nursery systems offer an important opportunity to increase profits. Properly designed and operated nurseries are highly biosecure facilities to grow postlarvae at very high densities.

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Building a better shrimp nursery, part 2

Shrimp nursery systems offer the shrimp industry an important opportunity to increase profits, by helping produce strong, healthy and uniform juveniles with significant potential for compensatory growth after their transfer for final pond grow-out. Biofloc technology and water quality are critical components of shrimp nursery systems.

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Acclimating shrimp postlarvae before pond stocking

Shrimp postlarvae acclimation before stocking into the various growout systems (ponds, raceways, tanks) is a critical – and often overlooked, sometimes taken for granted – step in the shrimp culture process. Various water quality parameters should be changed slowly so that the young shrimp have the time to gradually adapt to the new conditions.

Aquafeeds

Biofloc consumption by Pacific white shrimp postlarvae

The stable isotopes technique with δ13C and δ15N can be used to determine the relevance of different food sources to shrimp feeding during the pre-nursery phase of Litopenaeus vannamei culture. During this trial, different types of commercial feed, microalgae, Artemia sp. nauplii and bioflocs were used as food sources.

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