# Management and feeding strategies for successful nursery systems

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# Intensive Nursery Systems

- High biosecurity systems for post-larvae grown at high densities from 2 mg to sizes as large as 3 g, resulting in healthy, strong and uniform juveniles with significant potential for compensatory growth after transfer to the growout system.

Images from T. Samocha

# Advantages of Nursery Systems

- Greater control of diet, feed management, and water quality
- Faster growth
- Production of bigger and stronger juveniles with better survival and high potential for compensatory growth
- Indoor rearing systems allow early stocking of PLs during cold seasons to provide an initial advantage in growth

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# Advantages of Nursery Systems

- Management Strategy for WSSV by maintaining nursery temperatures above 30 ° C during seasons when temperatures in ponds are low
- A more developed immune system
- AHPNS Management Strategy: Allows stocking of large juveniles, with better resistance to AHPNS
- More efficient use of growout ponds by shortening the growout cycle, resulting in more crops per year

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# Disadvantages of Nursery Systems

- Increased handling of shrimp
- As stocking density goes up and water exchange is decreased, higher organic loading increases risk
- Less tolerant of <u>operator and system failures</u>
- Higher infrastructure, operations cost and labor requirement
  - Requires trained biologists
  - Higher construction costs than conventional pond systems
- Transfer related stress

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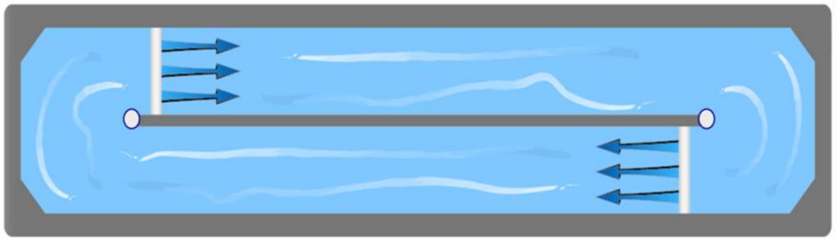
# Design

- Lined ponds covered by plastic greenhouses or roofs suspended by cables.
- Area: 300 – 7500 $m^2$
- Shape:
  - Rectangular – continuous rotating current around a central baffle
  - Square or round – typically with circular flow around a central drain. Facilitates capture and elimination of solid wastes.
- Stocking densities: 500 – 10,000 PLs / $m^3$
- Harvest size: 0.3 – 3 g
- Harvest biomass: 1 – 3 kg/m3

# Design Criteria

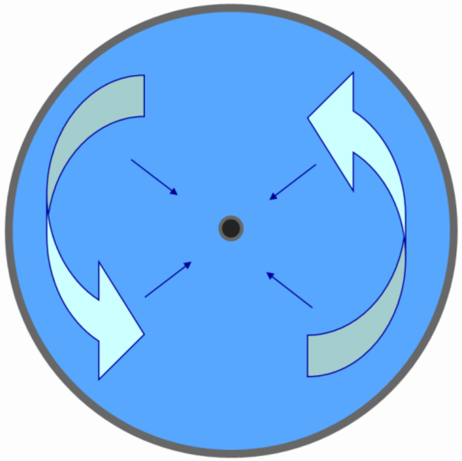
## Raceway

- Efficient utilization of space in the greenhouse
- Depending on materials may be expensive to build



## Round Tanks

- Central drain facilitates removal of solid wastes
- Inexpensive to build  and easy to manage;  inefficient space utilization



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# Water Supply and Treatment

- The water source should be as clean as possible
- Can be pumped into reservoirs for treatment or directly into production systems
- Initial filtration through a sand filter
- Chlorination – 20 ppm
- De-chlorination by aeration, thiosulfate or Vitamin C
- Ozonation is optional
- Final filtration – 5-50 micron cartridge filter

# Equipment

## Aration

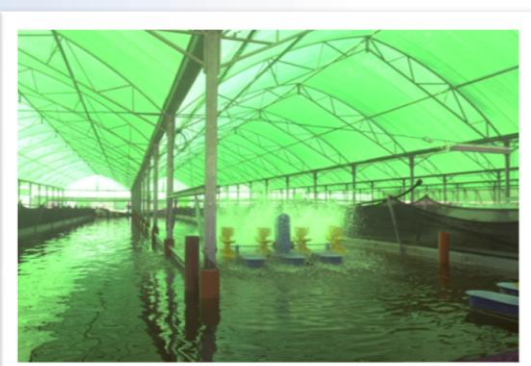
- Blowers/tubing, pump/venturi, paddlewheels
- Maintain resuspension of organics

## Water circulation

- Airlifts, venturis, paddlewheels, $AerO_2$

## Backup Systems

- Sensors, alarms, backup for power failure




Images from T. Samocha

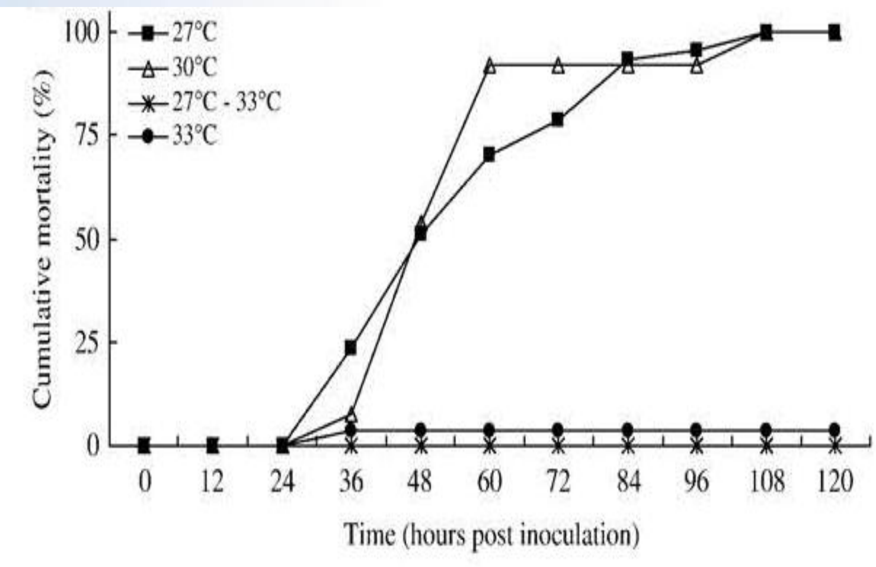
# PL Source

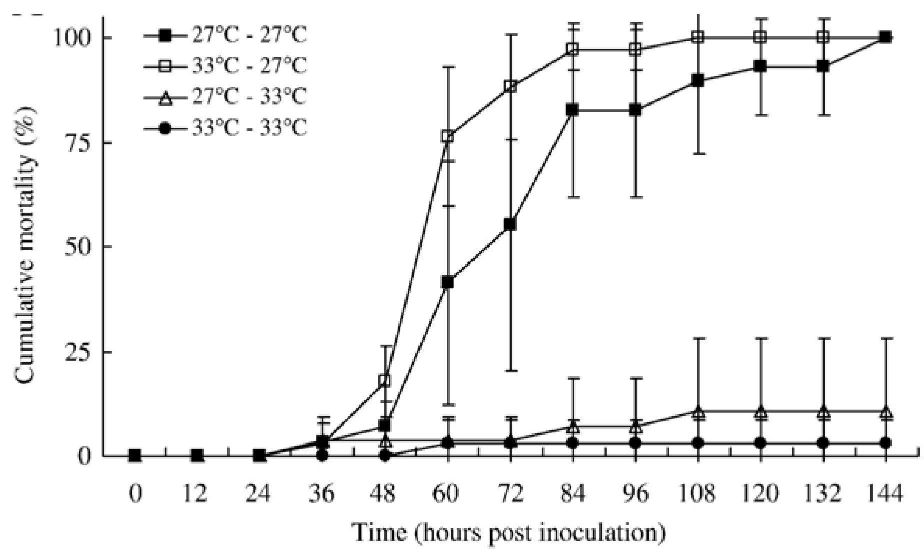
**PL quality and health is critical**

- PL from a genetic selection program
- PL should be free from excludable pathogens
- PL resistant or tolerant to local pathogens
- PL genetically selected for growth, and high survival and yield in the culture environment where they will be grown

# OIE Guidelines WSSV

- With no host, WSSV is viable in pond water for at least 3–4 days
- The best life stage for detection is late PL stages, juveniles and adults




Rahman et al. 2006

# Quality Assurance

The farmer should be responsible for carrying out:

- Verification of PL counts
- Determination of the average weight and coefficient of variation of the PLs stocked
- PCR testing for excludable pathogens
- Hatchery source evaluation
- Microscopic observations
- Stress tests

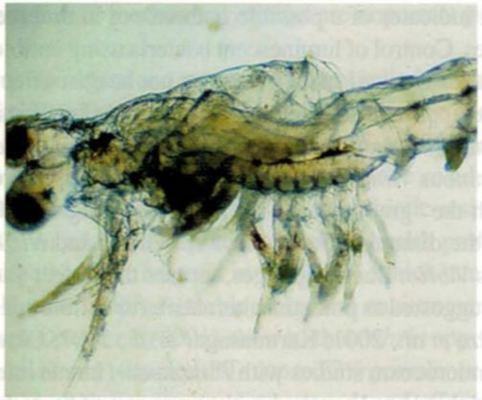


**Figure 8.** Postlarval blue shrimp (*Penaeus stylirostris*) with vibriosis. Necrosis of several appendages (pleopods and pereiopods) is indicated by melanized foci or tips. A dark oral region is indicative of bacterial colonization of the cuticle of the oesophagus and mouth appendages. Wet-mount; no stain. Magnification 50X. Photo courtesy of DV Lightner, University of Arizona, Aquaculture Pathology Laboratory.

# Stocking

- Water should be prepared with a stable bloom before stocking
- Acclimation for temperature and salinity
- Feed should be in the system as the animals are added
- Overfeed 5x the first two days from proven feeding tables
- Feeds used in hatchery should make up at least half of the daily feed requirements of transferred animals for at least the first three days.
- Quantify transport mortality
    - Stock animals on a tray or in a small net cage in tank

# Biofloc Technology

In the last 10 years biofloc technology has become commonly used in intensive shrimp culture systems.

The technology offers some big advantages:

- Potential for controlling nitrogenous wastes without need for water exchange or external biofilters
- The floc contributes to the nutrition of the shrimp
- Diverse microbial community displaces pathogens

- Maintain oxygen >4ppm and complete resuspension of organic matter

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# Misconceptions about Bioflocs

- Myth: **“Biofloc systems are zero exchange systems”**

  Truth: Limited exchange for removal of excess biofloc is required to keep these systems stable

- Myth: **“You have to add molasses or sugar to maintain a biofloc”**

  Truth: One can manage biofloc systems with little or no sugar or molasses . Bioflocs maintained with less sugar input are often more stable.

# Control of Nitrogenous Wastes

- Nitrogenous wastes are controlled through the management of bacterial populations in the water.
- There are two major classes of  bacteria:
  - Autotrophic bacteria (nitrifying bacteria): Use inorganic nitrogen ($NH_4$ and $NO_2$) for protein synthesis
  - Heterotrophic bacteria: Use both organic and inorganic sources of nitrogen) to the protein synthesis
- Both exist in the floc; the ratio is determined by the C: N ratio
- Adding molasses or sugar raises the C:N ratio and increases the proportion of heterotrophic bacteria. But this also results in increased oxygen demand, and higher TSS levels.

# Establishing a Biofloc

## Recommendation of Dr. Samocha:

- Add a probiotic like EZ Bio daily, beginning before the start of the production cycle.
- At the start of the production cycle, add sugar in proportion to the amount of feed added (30%)
- Measure all forms of nitrogen ($NH_4$-N, $NO_2$-N, $NO_3$-N) daily. When nitrate appears, gradually begin decreasing the amount of sugar added, eliminating it in about 5-7 days.
- Doing this results in a biofloc composed of both heterotrophic bacteria and autotrophic bacteria – a Mixotrophic System
- Mixotrophic Systems are more stable with lower TSS levels and lower oxygen demand

# Carbon Additions

- Estimate nitrogen according to feed protein

| | | | | |
|---|---|---|---|---|
| Feed CP content (%) | 35 | 40 | 45 | 50 |
| TAN into system (g) | 28 | 32 | 36 | 40 |

  1 kg of 50% CP feed = 40 g of TAN

- Determine the proportion of ammonia to be made available to the heterotrophic bacteria

  1 kg of 50% CP feed =- 40 x 0.5 = 20 g TAN

- Assume C:N ratio of 6:1 for assimilation

  20 x 6 = 120 g C

# Carbon Additions

- Divide carbon demand by the proportion of carbon in the particular carbon source

  White sugar = 42.1% C

  120 ÷ 0.421 = 285 g sugar per kg feed

| Carbon Source | % Carbon |
|---|---|
| **Cellulose ($C_6H_{10}O_5$) or Starches** | 44.4 |
| **Glucose ($C_6H_{12}O_6$)** | 40.0 |
| **Molasses (~50% sucrose- $C_{12}H_{22}O_{11}$)** | 24 - 37.5 |

# Probiotics

## Primary benefits

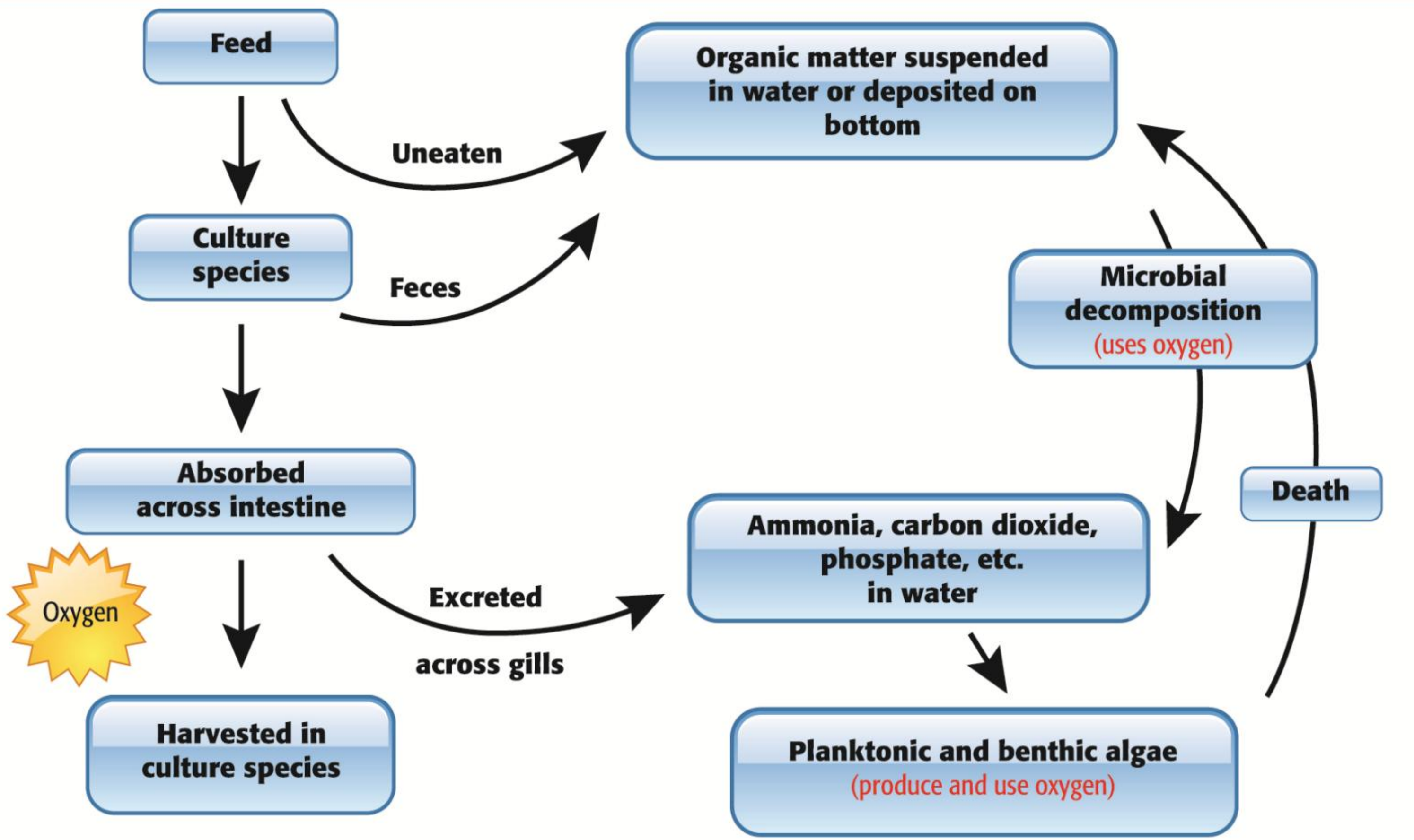
- **Water treatment**
  - Digestion of organic material
  - Reduction of ammonia levels
  - Initiation of the biofloc
- **Disease control**
  - Production of antimicrobial agents
  - Exclusion of pathogens

# The Key to Success

## The key to intensive nursery success:

# Feed Management

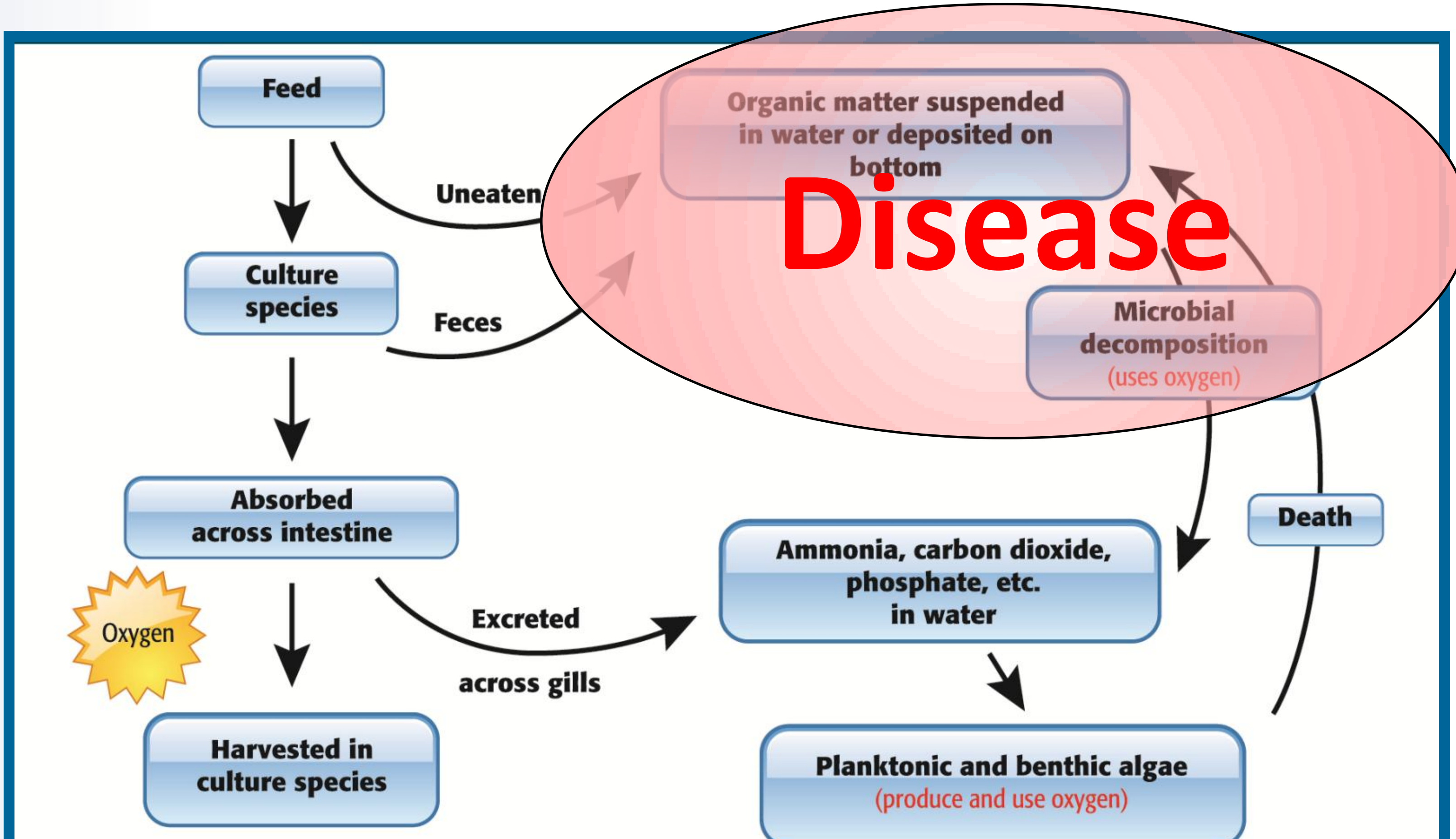
# Feed Drives the System




The fate of feed applied to aquaculture ponds.

-Boyd 2009

# Feed Drives the System




The fate of feed applied to aquaculture ponds.

-Boyd 2009

# Precision Feeding

Precision Feeding Concept:

**Provide each Animal with:**

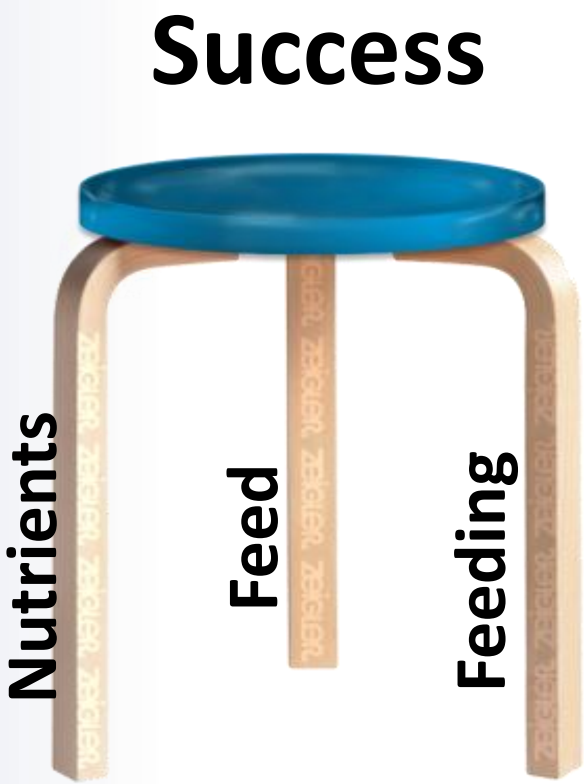
- the exact quantity of feed that it can consume,
- when the animal is ready to consume it,
- the exact nutrition that the animal requires,
- the correct feed particle sizes and optimum texture,
- In the location where the animal is located

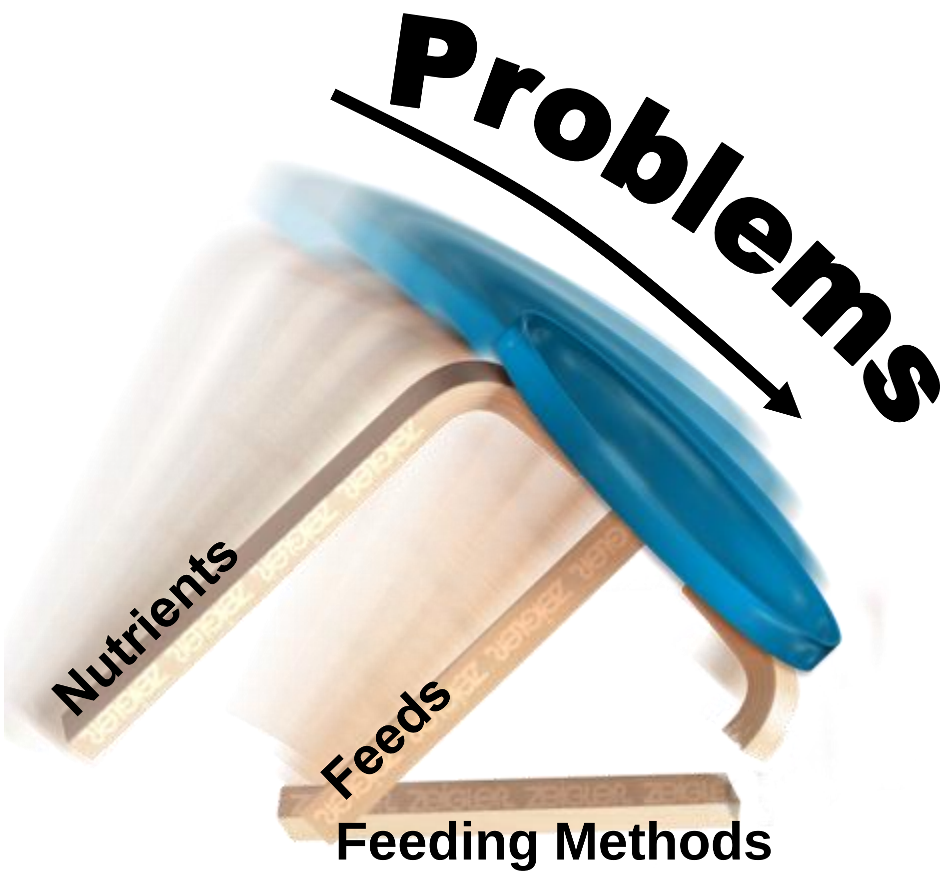
**“With the objective to optimize the desired results”**

# Elements of a Successful Feed Program

- Nutrients
  - The feed should contain all the nutrients required by the shrimp, in the required quantities
- Feed physical characteristics
  - Optimal size of particles
  - Water Stability
  - Palatability
- Feeding Methods

# Good Nutrition



# Diet Formulation

- Specialized ZBI raceway feed formulations
- Pond grower feeds inadequate
- Concentrated balance of essential nutrients
- Palatable, very digestible
- Void of toxins and anti-nutritionals
- Support health
  - Immune system balance
  - Stress management

↑ Nitrogen conversion efficiency

↓

↑ Growth

↓

↓ Water quality problems

# Feed Physical Characteristics

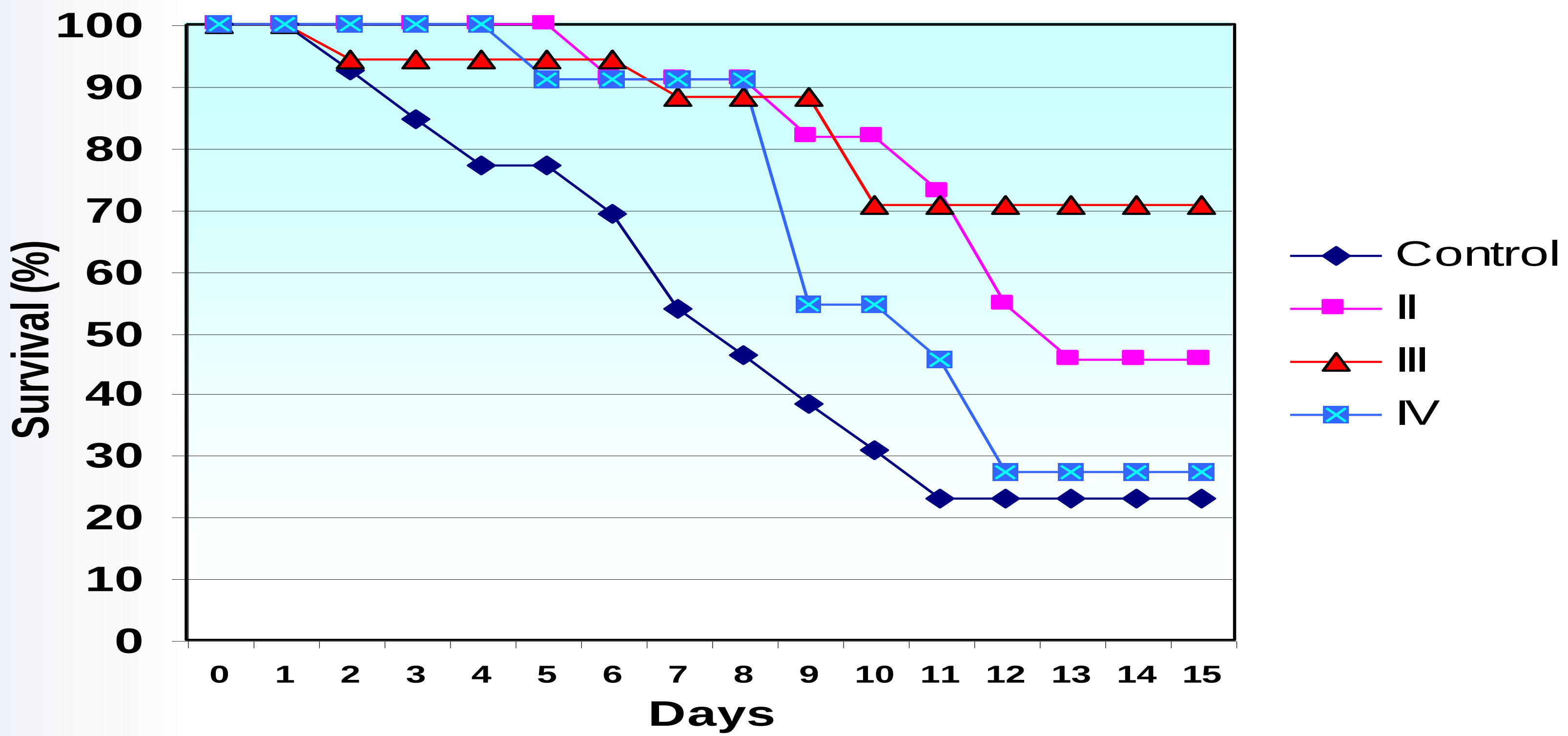
- Particle size and uniformity depend on shrimp size and uniformity
- Freshness – check labels for manufacture dates
- Packaged to retain quality, shelf life and palatability
- Water stability adequate to retain nutrients
- Shape and <u>texture</u> as preferred by shrimp
- Proper storage

# Specialized Diets Intensive Nursery Systems

- Grower feeds are not adequate
- Specially formulated diets for raceways
- Concentrated nutritional profile allowing reduced feeding necessary to maintain water quality
- Palatable, highly digestible
- No toxins or antinutritionals
- Vpak® is added to support animal health and resistance to diseases
  - A balanced immune system
  - Stress management

# Nutritional Immunology - Vpak™

Laboratory WSSV Challenge



# Driving a Ferrari on a Dirt Road

# Overfeeding

- Overfeeding is a very common mistake with very serious consequences, including:
  - Increases floc and bacteria populations
  - Increases requirements for probiotics
  - Increases oxygen demand, $CO_2$ production
  - Increases ammonia and nitrite production
  - Sludge accumulation, toxic hydrogen sulfide

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# Traditional Feed Tables

- Traditionally, producers have used feed tables based on the concept of % Biomass/Day:

*Feed Amount = Biomass x % Biomass/day*

- These tables were developed empirically for a single set of conditions
- They are not based on the biology of shrimp growth
- When conditions change, the feed tables are no longer appropriate

| Average Weight (g) | Percent Biomass/Day |
|---|---|
| 0.002 | 50.0% |
| 0.005 | 46.0% |
| 0.01 | 42.0% |
| 0.02 | 36.0% |
| 0.03 | 30.0% |
| 0.04 | 22.4% |
| 0.05 | 18.0% |
| 0.06 | 17.0% |
| 0.07 | 16.5% |
| 0.08 | 16.0% |
| 0.09 | 15.5% |
| 0.1 | 15.5% |
| 0.2 | 13.0% |
| 0.3 | 12.5% |
| 0.4 | 12.0% |
| 0.5 | 11.6% |
| 0.6 | 11.4% |
| 0.7 | 11.0% |
| 0.8 | 10.8% |
| 0.9 | 10.4% |
| 1 | 10.2% |
| 1.25 | 9.4% |
| 1.5 | 8.8% |
| 1.75 | 8.4% |
| 2 | 7.8% |
| 2.25 | 7.4% |
| 2.5 | 7.0% |
| 2.75 | 6.4% |
| 3 | 6.0% |

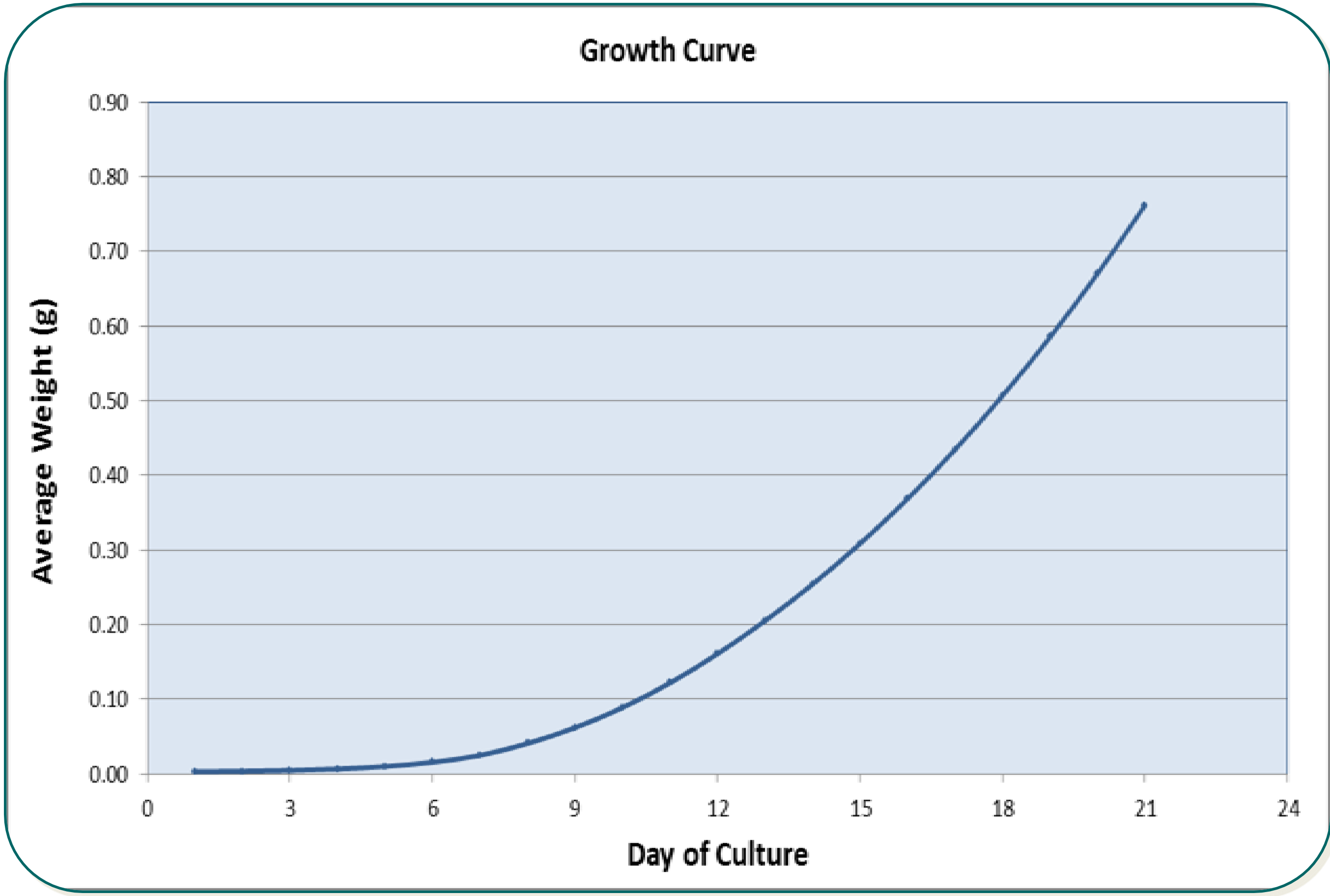
# Feeding is based on Gains and Expected FCR

- A better method of calculating growth rates:
  1. Develop a typical growth curve for the growing conditions
  2. Calculate the daily weight gain
  3. Multiply the expected gain by the Population Estimate and Expected Feed Conversion Factor (FCR)

***Feed Quantity = Daily Gain x Population x FCR***

# Exponential Growth Curve

- During the nursery stage the growth is exponential
- Adjust the feeding on a daily basis



# Feeding Table is Based on Expected Growth and FCRs

| Day of Culture | Survival % | Estimated Population | Average Weight (g) | Predicted Gain/Day (g) | Predicted Daily FCR | Daily Feed Amt - Dry Wt (kg) |
|---|---|---|---|---|---|---|
| 1 | 100% | 500,000 | 0.003 | 0.001 | 0.71 | 5 |
| 2 | 95% | 472,500 | 0.004 | 0.001 | 0.71 | 5 |
| 3 | 94% | 470,000 | 0.005 | 0.002 | 0.72 | 5 |
| 4 | 94% | 467,500 | 0.007 | 0.003 | 0.74 | 5 |
| 5 | 93% | 465,000 | 0.010 | 0.006 | 0.75 | 5 |
| 6 | 93% | 462,500 | 0.016 | 0.009 | 0.76 | 5 |
| 7 | 92% | 460,000 | 0.025 | 0.016 | 0.78 | 6 |
| 8 | 92% | 457,500 | 0.041 | 0.021 | 0.79 | 8 |
| 9 | 91% | 455,000 | 0.062 | 0.027 | 0.80 | 10 |
| 10 | 91% | 452,500 | 0.089 | 0.033 | 0.81 | 12 |
| 11 | 90% | 450,000 | 0.122 | 0.039 | 0.83 | 15 |
| 12 | 90% | 447,500 | 0.161 | 0.044 | 0.84 | 17 |
| 13 | 89% | 445,000 | 0.205 | 0.049 | 0.85 | 19 |
| 14 | 89% | 442,500 | 0.254 | 0.054 | 0.87 | 21 |
| 15 | 88% | 440,000 | 0.309 | 0.060 | 0.88 | 23 |
| 16 | 88% | 437,500 | 0.369 | 0.066 | 0.89 | 26 |
| 17 | 87% | 435,000 | 0.435 | 0.072 | 0.91 | 28 |
| 18 | 87% | 432,500 | 0.507 | 0.079 | 0.91 | 31 |
| 19 | 86% | 430,000 | 0.585 | 0.085 | 0.92 | 34 |
| 20 | 86% | 427,500 | 0.670 | 0.092 | 0.93 | 37 |
| 21 | 85% | 425,000 | 0.762 | 0.098 | 0.95 | 0 |

# Zeigler Precision Feed Program©

- Growth curve based on the system's history and genetics of animals
- The feeding is based on accurate population projections, gains per day, FCR, and temperature
- Includes a mechanism to adjust the feed rate on the basis of average weight samples, population estimates, adjustments to projected growth per day, and temperature.

# Zeigler Precision Feed Program©

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| Product of Zeigler Technology |
|---|
| Zeigler Bros. Inc. |
| © 2015 |

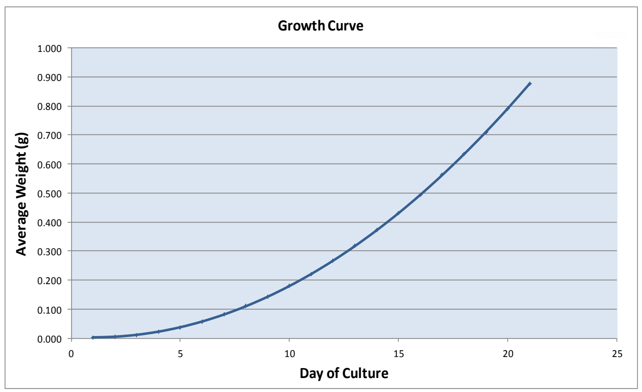
VERSION 2.0
Last Modified:
1/23/2016

| CHANGE ANY NUMBER IN BLUE CELLS | |
|---|---|
| LANGUAGE: | English |
| 0 | |

| Rearing Unit Volume (m3) | |
|---|---|
| Rearing Unit ID | Raceway 2 |
| Rearing Unit Volume (m3) | 0.03 m3 |
| Carrying Capacity | 1.50 kg/m3 |

| Seedstock | |
|---|---|
| Shrimp Origin | |
| Genetic Growth Potential (g/wk) | 1.50 g/week |

| Production Assumptions | |
|---|---|
| Stocking Date: | 11/1/2015 |
| Age of PLs Stocked: | PL 20 |
| Ave. Wt. of Shrimp Stocked (g) | 0.0030 |
| Number Stocked: | 30 |
| Stocking Density (pcs/m3) | 1,000 |
| Expected Stocking Mortality | 5.0% |
| Predicted Survival Rate | 80.0% |
| Culture Days | 21 |
| Expected Ave. Temp. (°C) | 30 |




| Particle Size | Feed Selection |
|---|---|
| EZ Artemia 300-300 µm | Not Used |
| <400 µm | PL Raceway Plus |
| 400-600 µm | Shrimp Starter |
| 600-850 µm | PL Raceway 40-9 |
| 850 - 1200 µm | PL Raceway 40-9 |
| 1.5 mm | PL Raceway 40-9 |
| 2.0 mm | PL Raceway 40-9 |
| 2.4 mm | HI - 35 |

| SUMMARY OF FEED REQUIREMENTS | | | | | | |
|---|---|---|---|---|---|---|
| Not Used 300 - 500 µm | PL Raceway Plus <400 µm | Shrimp Starter <600 µm | PL Raceway 40-9 600-850 µm | PL Raceway 40-9 850-1200 µm | PL Raceway 40-9 1.5 mm | PL Raceway 40-9 2.0 mm |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

DAILY FEED REQUIREMENT BY FEED TYPE & PARTICLE SIZE

| Date | Day of Culture | Stage | Survival % | Estimated Population | Corrected Population Estimate | Predicted Ave. Wt. (g) | Sample Ave. Wt. (g) | Growth Adjustment Factor (% of Max) | Predicted Temperature (°C) | Biomass (kg) | Density (kg/m3) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/1/2015 | 1 | PL 20 | 100% | 30 | | 0.0030 | | 100% | 30 | 0.0 | 0.00 |
| 6/2/2016 | 2 | PL 21 | 94.3% | 28 | | 0.0052 | | 100% | 30 | 0.0 | 0.00 |
| 6/3/2016 | 3 | PL 22 | 93.5% | 28 | | 0.0117 | | 100% | 30 | 0.0 | 0.01 |
| 6/4/2016 | 4 | PL 23 | 92.8% | 28 | | 0.0227 | | 100% | 30 | 0.0 | 0.02 |
| 6/5/2016 | 5 | PL 24 | 92.0% | 28 | | 0.0379 | | 100% | 30 | 0.0 | 0.03 |
| 6/6/2016 | 6 | PL 25 | 91.3% | 27 | | 0.0576 | | 100% | 30 | 0.0 | 0.05 |
| 6/7/2016 | 7 | PL 26 | 90.5% | 27 | | 0.0816 | | 100% | 30 | 0.0 | 0.07 |
| 6/8/2016 | 8 | PL 27 | 89.8% | 27 | | 0.1100 | | 100% | 30 | 0.0 | 0.10 |
| 6/9/2016 | 9 | PL 28 | 89.0% | 27 | | 0.1427 | | 100% | 30 | 0.0 | 0.13 |
| 6/10/2016 | 10 | PL 29 | 88.3% | 26 | | 0.1799 | | 100% | 30 | 0.0 | 0.16 |
| 6/11/2016 | 11 | PL 30 | 87.5% | 26 | | 0.2213 | | 100% | 30 | 0.0 | 0.19 |
| 6/12/2016 | 12 | PL 31 | 86.8% | 26 | | 0.2672 | | 100% | 30 | 0.0 | 0.23 |
| 6/13/2016 | 13 | PL 32 | 86.0% | 26 | | 0.3174 | | 100% | 30 | 0.0 | 0.27 |
| 6/14/2016 | 14 | PL 33 | 85.3% | 26 | | 0.3720 | | 100% | 30 | 0.0 | 0.32 |
| 6/15/2016 | 15 | PL 34 | 84.5% | 25 | | 0.4309 | | 100% | 30 | 0.0 | 0.36 |
| 6/16/2016 | 16 | PL 35 | 83.8% | 25 | | 0.4943 | | 100% | 30 | 0.0 | 0.41 |
| 6/17/2016 | 17 | PL 36 | 83.0% | 25 | | 0.5619 | | 100% | 30 | 0.0 | 0.47 |
| 6/18/2016 | 18 | PL 37 | 82.3% | 25 | | 0.6340 | | 100% | 30 | 0.0 | 0.52 |
| 6/19/2016 | 19 | PL 38 | 81.5% | 24 | | 0.7104 | | 100% | 30 | 0.0 | 0.58 |
| 6/20/2016 | 20 | PL 39 | 80.8% | 24 | | 0.7912 | | 100% | 30 | 0.0 | 0.64 |
| 6/21/2016 | 21 | PL 40 | 80.0% | 24 | | 0.8763 | | 100% | 30 | 0.0 | 0.70 |

| Date | Predicted Gain/Day (g) | Predicted Daily FCR | Feed per Animal /day (mg) | Daily Feed Amt - Dry Wt (kg) | Cumulative Feed Amt (kg) | Cumulative FCR | Not Used 300 - 500 µm | PL Raceway Plus <400 µm | Shrimp Starter <600 µm | PL Raceway 40-9 600-850 µm | PL Raceway 40-9 850-1200 µm | PL Raceway 40-9 1.5 mm | PL Raceway 40-9 2.0 mm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11/1/2015 | 0.0022 | 0.645 | 7.0 | 0.00 | 0 | | | 0.00 | | | | | |
| 6/2/2016 | 0.0066 | 0.66 | 7.5 | 0.00 | 0 | 3.74 | | 0.00 | | | | | |
| 6/3/2016 | 0.0109 | 0.67 | 7.3 | 0.00 | 0 | 1.77 | | 0.00 | 0.00 | | | | |
| 6/4/2016 | 0.0153 | 0.68 | 10.4 | 0.00 | 0 | 1.16 | | | 0.00 | 0.00 | | | |
| 6/5/2016 | 0.0197 | 0.69 | 13.6 | 0.00 | 0 | 0.96 | | | 0.00 | 0.00 | | | |
| 6/6/2016 | 0.0240 | 0.70 | 16.9 | 0.00 | 0 | 0.87 | | | | 0.00 | | | |
| 6/7/2016 | 0.0284 | 0.72 | 20.3 | 0.00 | 0 | 0.83 | | | | 0.00 | | | |
| 6/8/2016 | 0.0328 | 0.73 | 23.9 | 0.00 | 0 | 0.80 | | | | 0.00 | 0.00 | | |
| 6/9/2016 | 0.0371 | 0.74 | 27.5 | 0.00 | 0 | 0.79 | | | | 0.00 | 0.00 | | |
| 6/10/2016 | 0.0415 | 0.75 | 31.2 | 0.00 | 0 | 0.79 | | | | | 0.00 | | |
| 6/11/2016 | 0.0459 | 0.76 | 35.0 | 0.00 | 0 | 0.79 | | | | | 0.00 | | |
| 6/12/2016 | 0.0502 | 0.78 | 39.0 | 0.00 | 0 | 0.79 | | | | | 0.00 | | |
| 6/13/2016 | 0.0546 | 0.79 | 43.0 | 0.00 | 0 | 0.80 | | | | | 0.00 | | |
| 6/14/2016 | 0.0590 | 0.80 | 47.2 | 0.00 | 0 | 0.80 | | | | | 0.00 | 0.00 | |
| 6/15/2016 | 0.0633 | 0.81 | 51.4 | 0.00 | 0 | 0.81 | | | | | 0.00 | 0.00 | |
| 6/16/2016 | 0.0677 | 0.82 | 55.8 | 0.00 | 0 | 0.82 | | | | | 0.00 | 0.00 | |
| 6/17/2016 | 0.0720 | 0.84 | 60.2 | 0.00 | 0 | 0.82 | | | | | 0.00 | 0.00 | |
| 6/18/2016 | 0.0764 | 0.85 | 64.8 | 0.00 | 0 | 0.83 | | | | | 0.00 | 0.00 | |
| 6/19/2016 | 0.0808 | 0.86 | 69.4 | 0.00 | 0 | 0.84 | | | | | | 0.00 | |
| 6/20/2016 | 0.0852 | 0.87 | 74.2 | 0.00 | 0 | 0.85 | | | | | | 0.00 | |
| 6/21/2016 | 0.0895 | 0.88 | 0.0 | 0.00 | 0 | 0.86 | | | | | | 0.00 | |

# Feeding Frequency and Distribution

- Continuous feeding is recommended because:
  - Shrimp eat continuously
  - The feed begins to lose nutritional value very quickly after entering the water column due to leaching of nutrients in the water.
  - Feed at least once per hour, 24 hours per day
- Feed equal amounts per feeding
- It is extremely important to distribute feed in a uniform manner to achieve consistent growth rates and low feed conversions.

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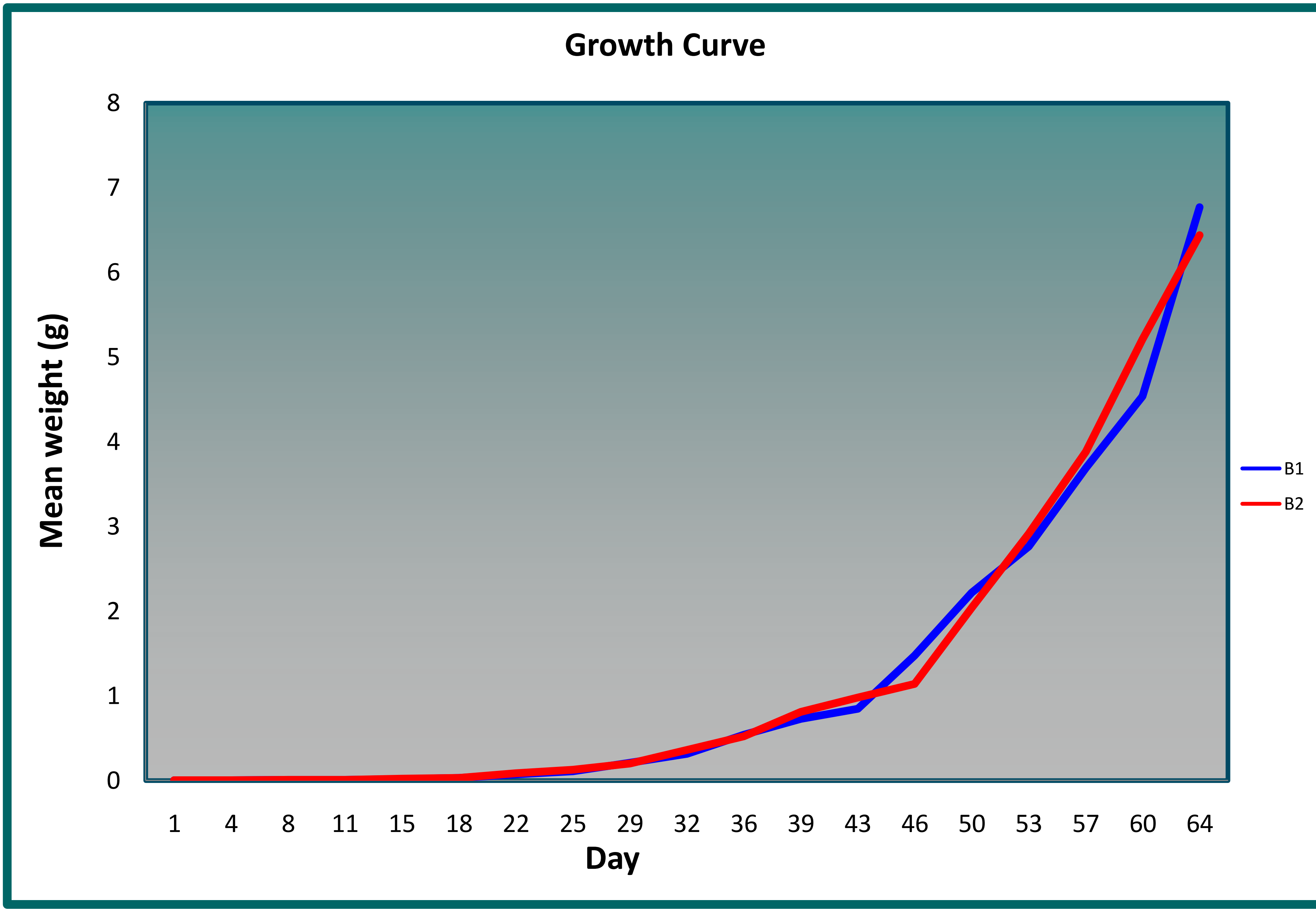
# Zeigler Feed Trial in Super-Intensive System

[1]Texas A&M AgriLife Research Mariculture Lab at Flour Bluff, Corpus Christi, Texas



Growth Curve
Mean weight (g)
8
7
6
5
4
3
2
1
0
1
4
8
11
15
18
22
25
29
32
36
39
43
46
50
53
57
60
64
Day
B1
B2

# Summary of the results of a feed trial in two raceways 100 $m^3$ stocked with P. *vannamei* at a density of 540 PL 4-8 / m3.

| RW | Yield ($kg/m^3$) | Av. Wt. (g) | Survival (%) | FCR | (g/wk) |
|---|---|---|---|---|---|
| 1 | 3.43 | 6.77 | 97.8 | 0.73 | 0.75 |
| 2 | 3.29 | 6.44 | 94.6 | 0.76 | 0.72 |

*

- No water exchange
- Duration: 62 days
- Days 0 – 8: EZ Artemia 300-500 microns
- Days 0 – 28: Raceway Plus (50:15)
- Days 29 – 62: PL Raceway 40-9

Samocha et al. 2015

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# Sucesso!



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