CP a market leader in shrimp aquaculture:

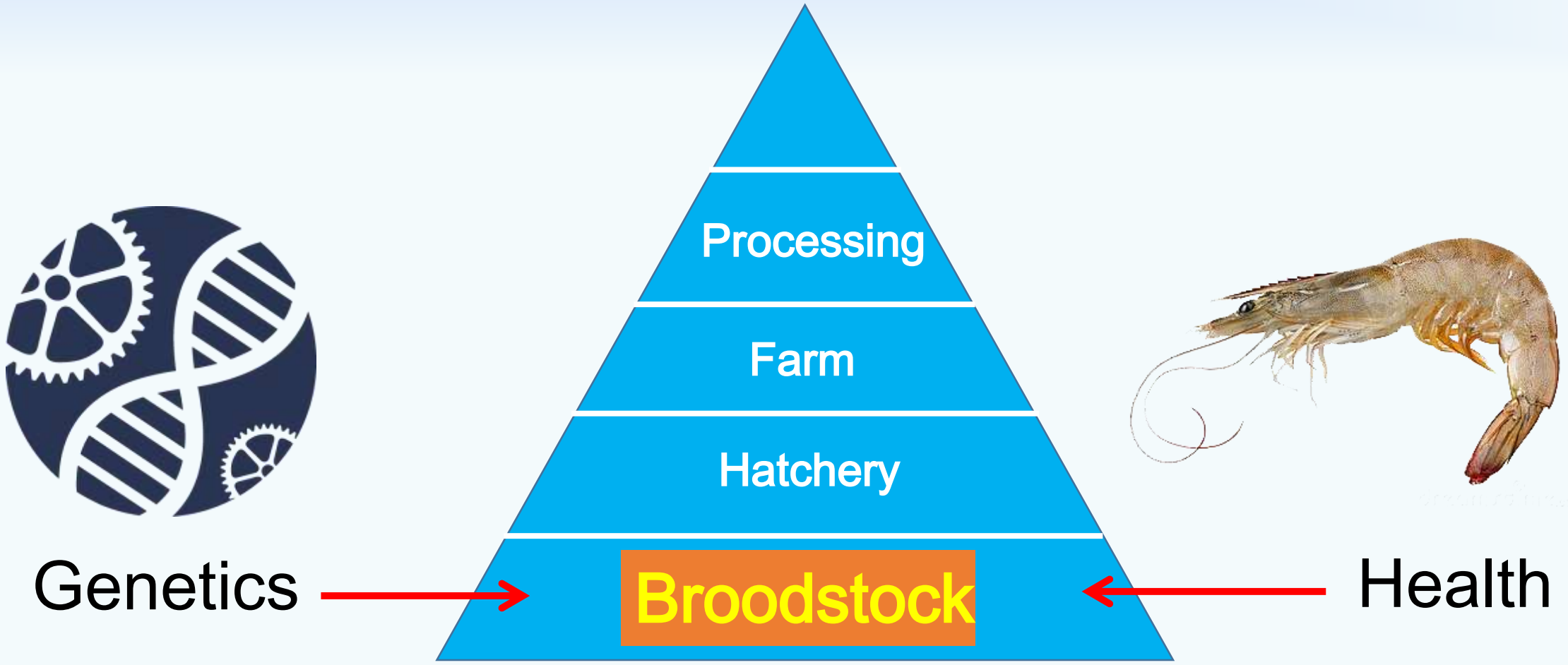
Dedicated to Producing highest quality at most reasonable pricing

Healthy Post Larvae: Thia is Most essential!

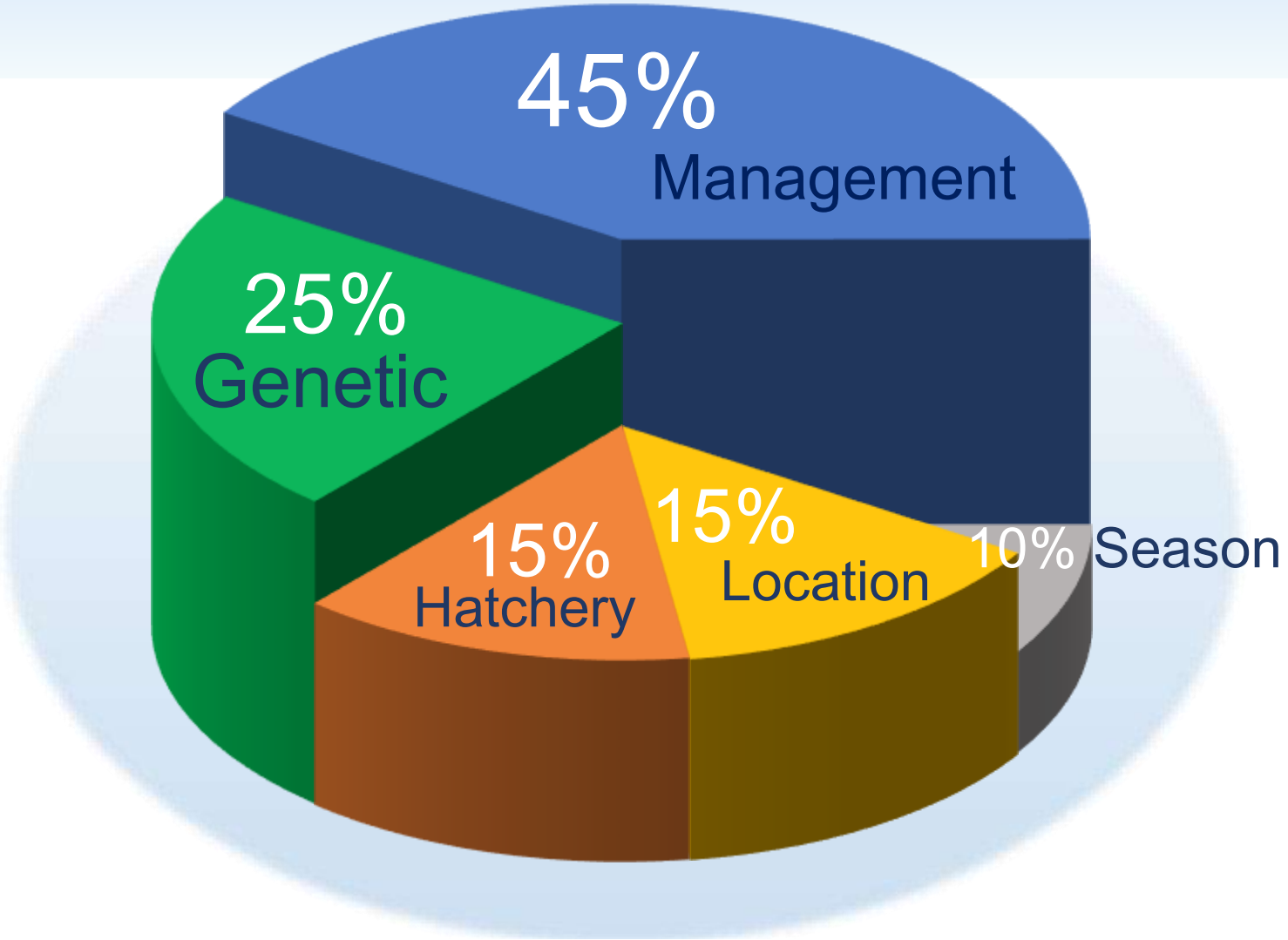
From Advanced Genetics:
P. Vannamei and P. mondon

The Aquaculture Pyramid

Broodstock are the foundation of this pyramid



Important: Variable Pond Performance is more than just shrimp genetics



APE *vs* SPF

Broodstock Health First

And Consistent health can only be obtained with SPF shrimp

Expensive programs but they are what delivers consistency

1. Strict Quarantine for Founders before entry
2. Nucleus Breeding Compartment; regular surveillance
3. List of pathogens being surveilled
4. Strictest of biosecurity;

Completely Closed System

Completely Closed Maturation

Broodstock tanks

Recycle

Maturation : Maturation Diet

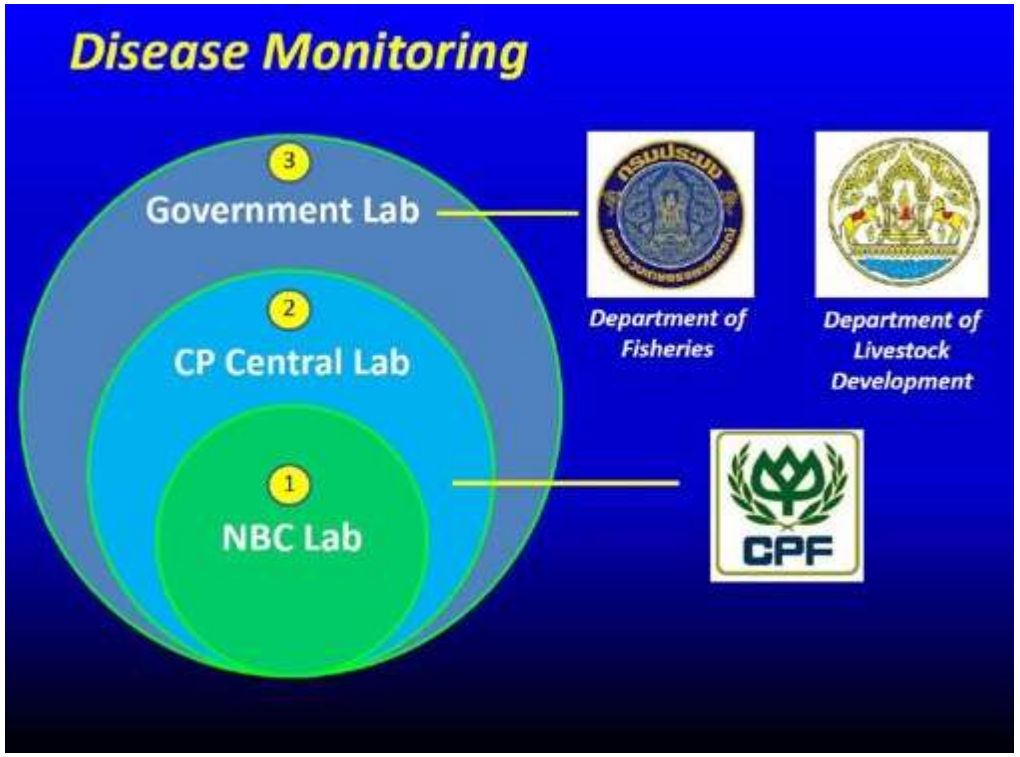
No live or Fresh Feed: Biosecure

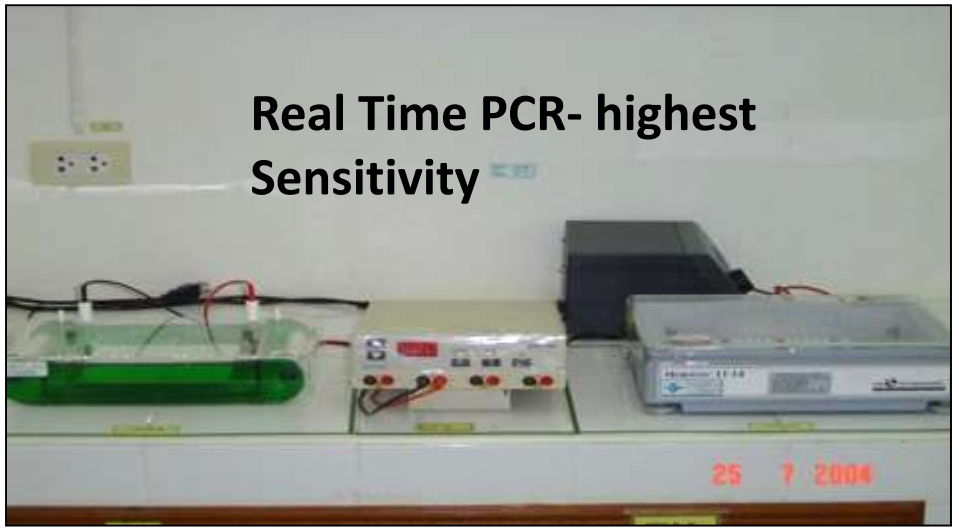
Larval Rearing : Phytoplankton

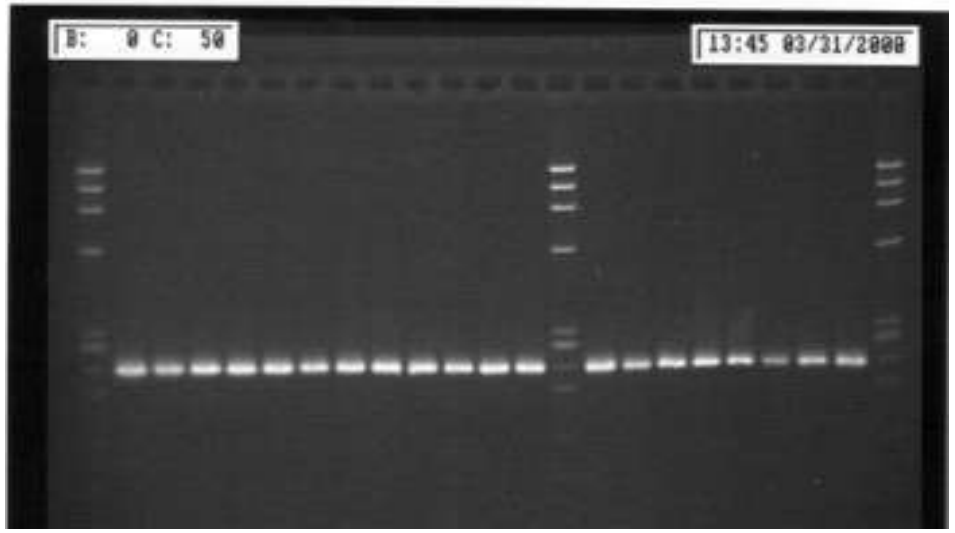
Larval Rearing : Nursery ; Individual Family Tank

Secure Broodstock Grow out

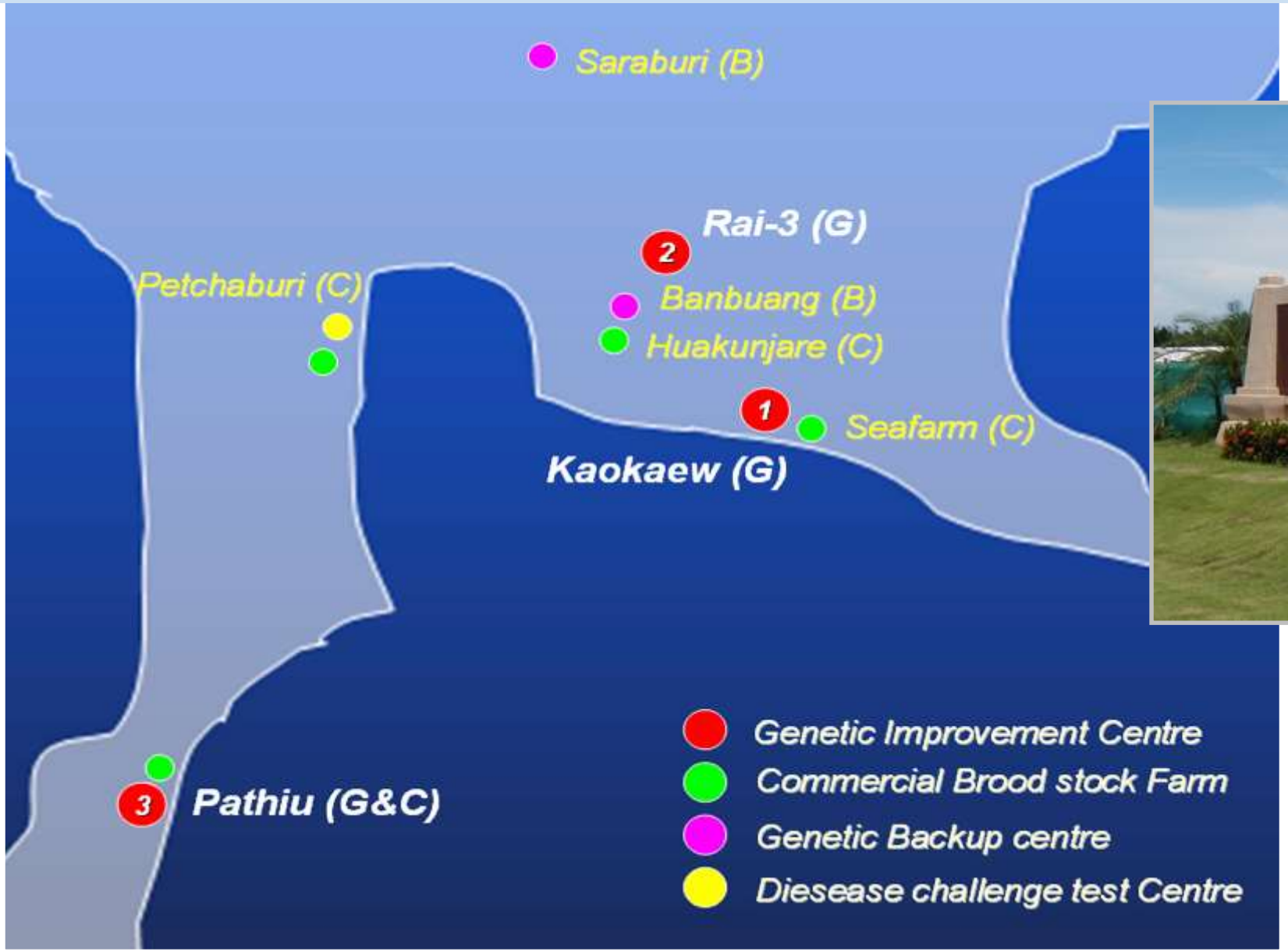
Multiple layers of Continuous Surveillance







Marine Shrimp Broodstock Program requires Multiple Facilities



Nucleus Breeding

Must have constant Surveillance of all known/possible pathogens

Not Just OIE pathogens

CHAROEN POKPHAND FOODS PUBLIC CO.,LTD

135/1 M.8, Nongkhanan, Mueang District, Phetchaburi 76000, Thailand

Establishment standard : Sor-Aor. 3 No: TH 7623160002

CERTIFICATE OF ANALYSIS

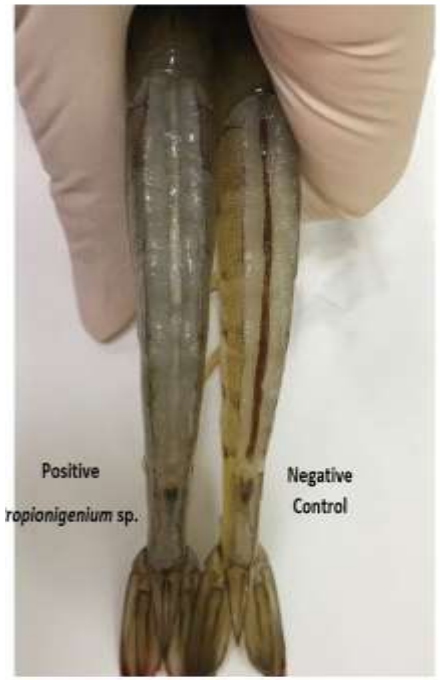
Year	No. of Sample														All Disease		
	IHHNV	IMNV	TSV	WSSV	YHV	EHP	AHPND	NHPB	DIV1	HPV	CMNV	BP	MBV	MrNV	No. of Sample	% Negative	% Positive
2013	604	604	604	604	604	6,113	60								9,193	100%	0%
2014	873	873	873	873	873	5,928	840								11,133	100%	0%
2015	654	654	654	654	654	3,955	900								8,125	100%	0%
2016	512	472	472	472	472	3,174	736								6,310	100%	0%
2017	457	432	433	434	435	4,607	1,326								8,124	100%	0%
2018	467	442	442	467	467	4,287	1,262	680	114	680					9,308	100%	0%
2019	2,613	1,156	1,156	2,984	2,613	5,439	3,780	2,306	688	2,642	19				25,396	100%	0%
2020	3,363	2,801	2,801	3,363	3,363	6,525	5,189	5,020	886	6,801	30	20			40,162	100%	0%
2021	1,510	1,510	1,510	1,510	1,510	4,119	2,469	2,591	268	3,934	40	50	40	40	21,101	100%	0%
Total	11,053	8,944	8,945	11,361	10,991	44,147	16,562	10,597	1,956	14,057	89	70	40	40	138,852		

This is certify that the processed white shrimp broodstock quality analysis which listed above has been analysed by CPF Central Laboratory

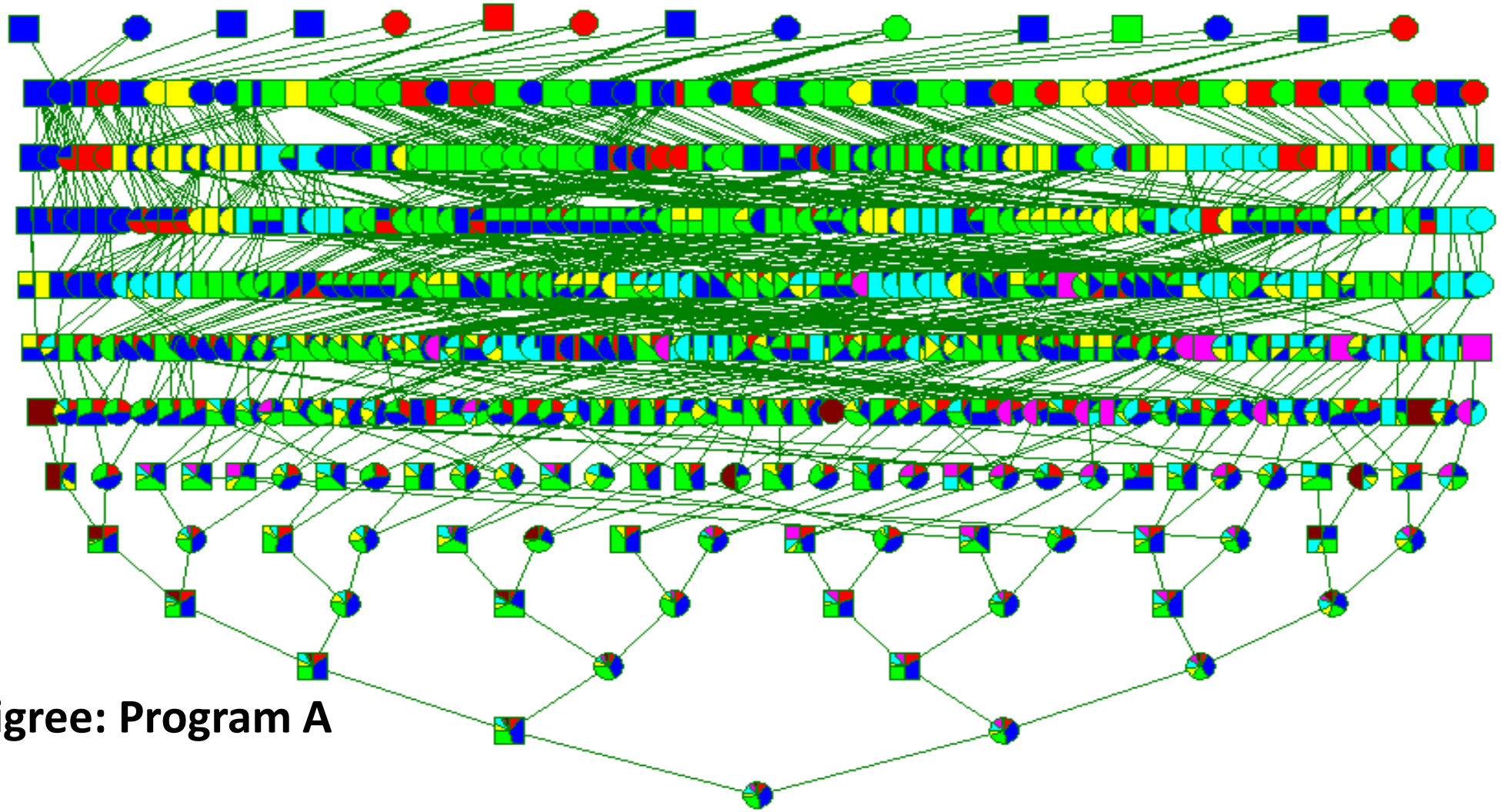
3000 tanks for family stress and disease challenge

AND our SPF list now includes:

White Feces= EHP +*Propionigenium sp.*



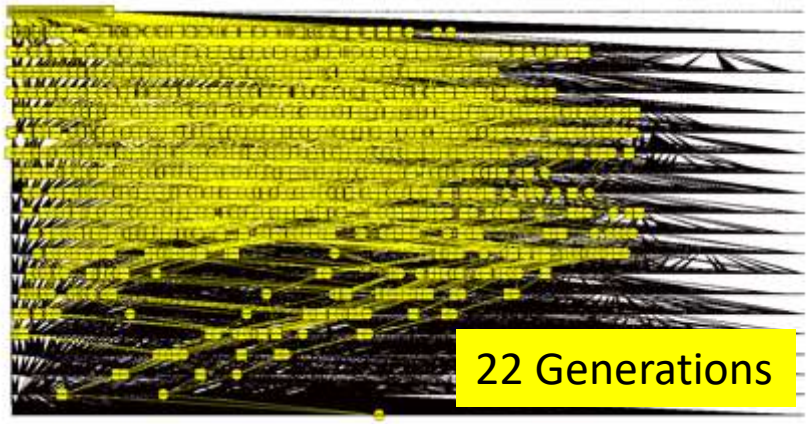
Pedigrees define a breeding program



CPF Pedigree: Program A

CPF Genetics breeding program

CPF was the first company in Asia to develop and operate SPF genetic centers and broodstock multiplication centers; starting operations in 2003. Since operations began CPF broodstock have been maintained disease free.



CP Family Pedigree

The Process

Broodstock — AI full-sib family

↓

Nauplii-PL45: 60 Families — Rearing in individual tanks

↓ Between Family selection

Best 2 Families for commercial

PL45-32g: 10-12 Families — Rearing in grow-out pond

↓ Within-family selection

Next Gen. Broodstocks

Family Based Breeding Strategy- Shrimp

CPF Broodstock : Disease Free SPF with Best balance of Genetic Traits

Require optimum culture conditions

Epigenetic conditioning

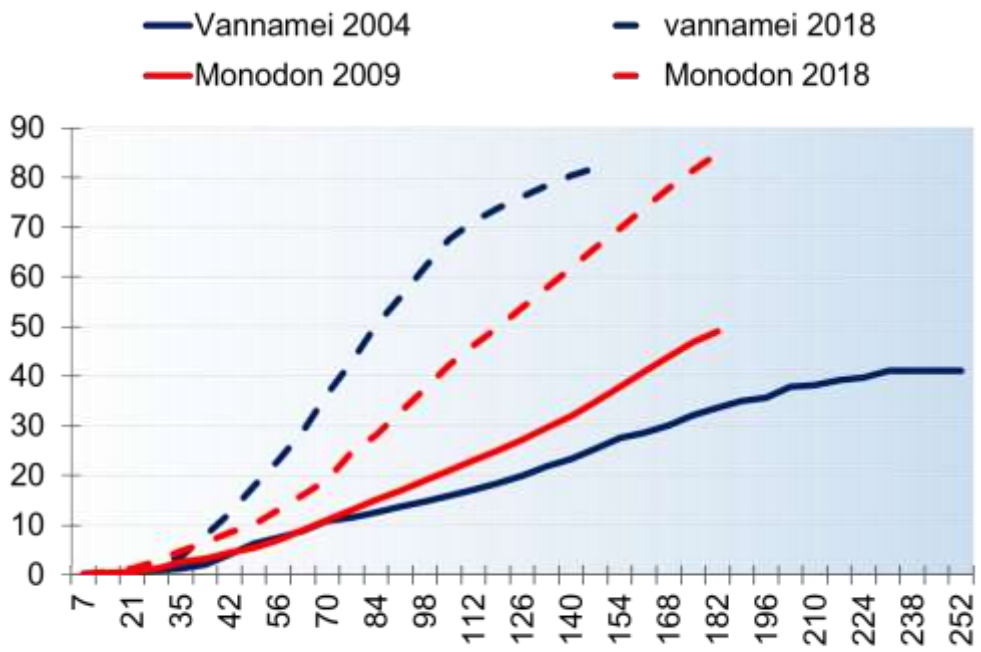
Require absolute biosecurity to maintain SPF status

Require selection of “best animals”: best growth, healthy, no defects

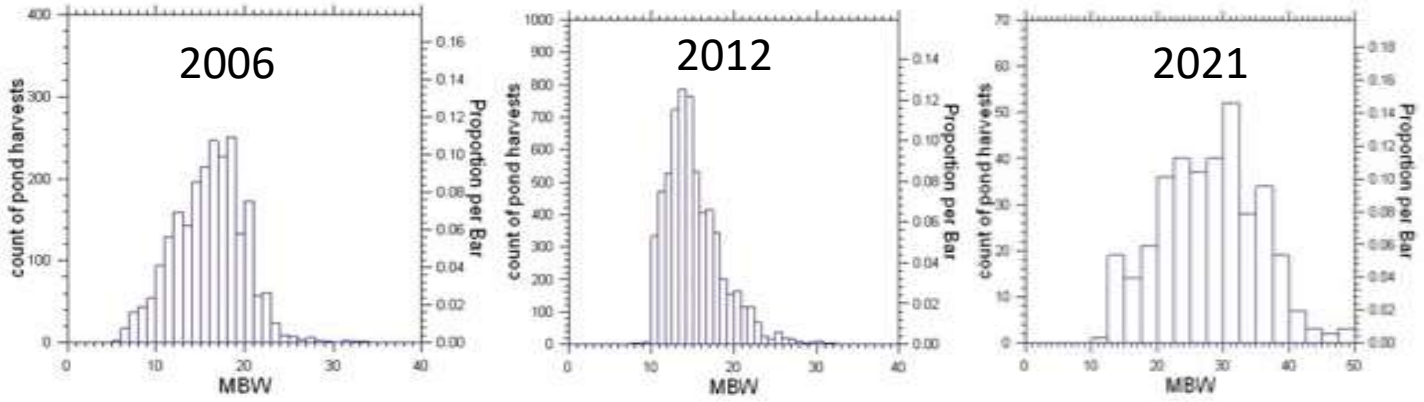
Genetics:

A Great Tool to increase production efficiency; but not a Solution for Problems

Growth



Size

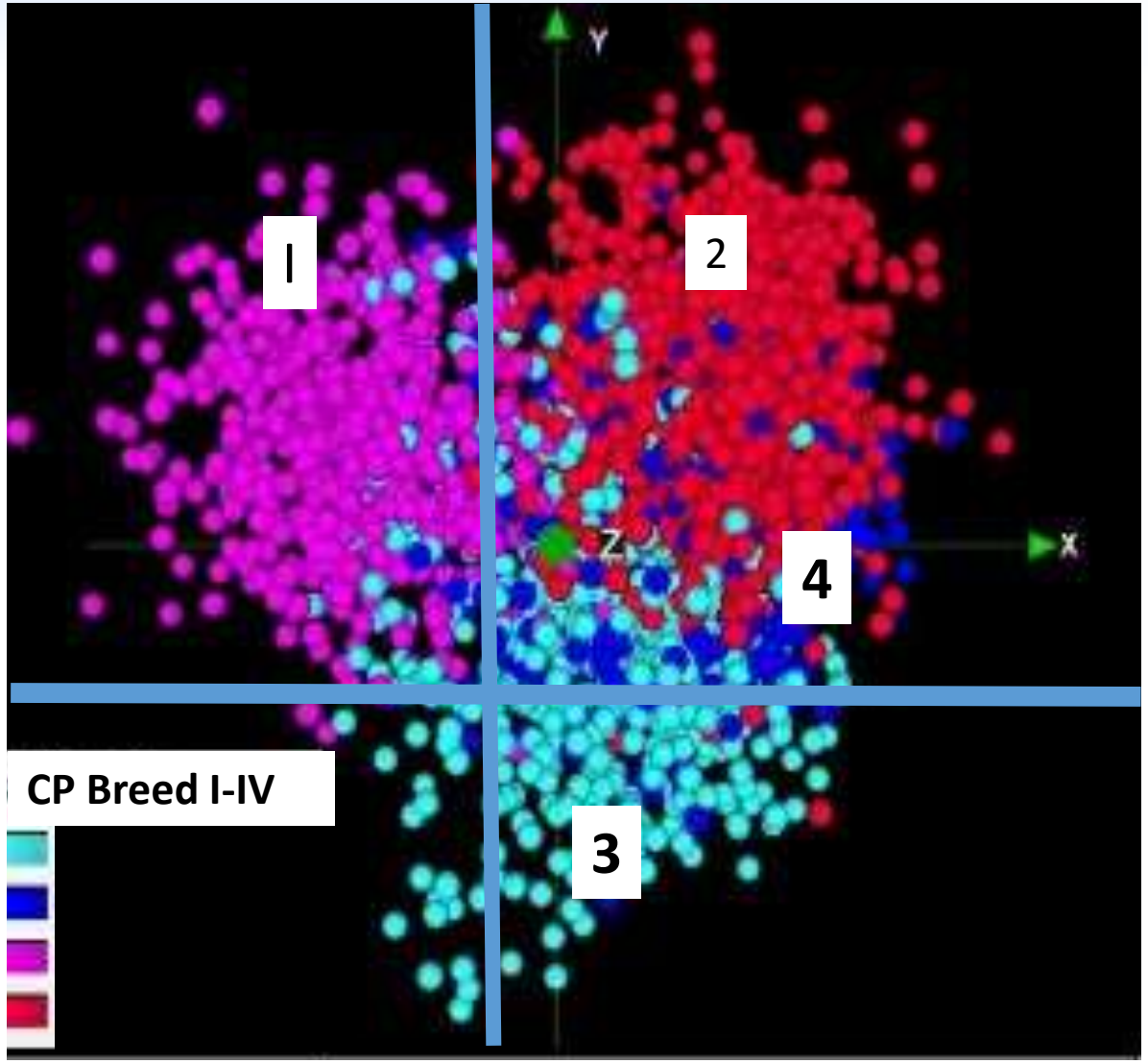


30 gms = 0 percent

>30 gms = 40 percent

CP Breeding minimizes inbreeding ; while maximizing Character gains

Breed	Heterozygosity
CP Turbo	0.38
CP Super Win	0.37
CP Kong	0.42
Competitor I	0.35
Competitor II	0.36
Competitro III	0.39
Competitor IV	0.40
Ecuador	0.38



CPF offers a full range of performance

Performance — **Robustness**

Best for Small Raceway | **Best for Ponds, Poly**

FAST WIN

Turbo

Super Win

Gator Tough

In development

Best Environment — **Challenging Environment**

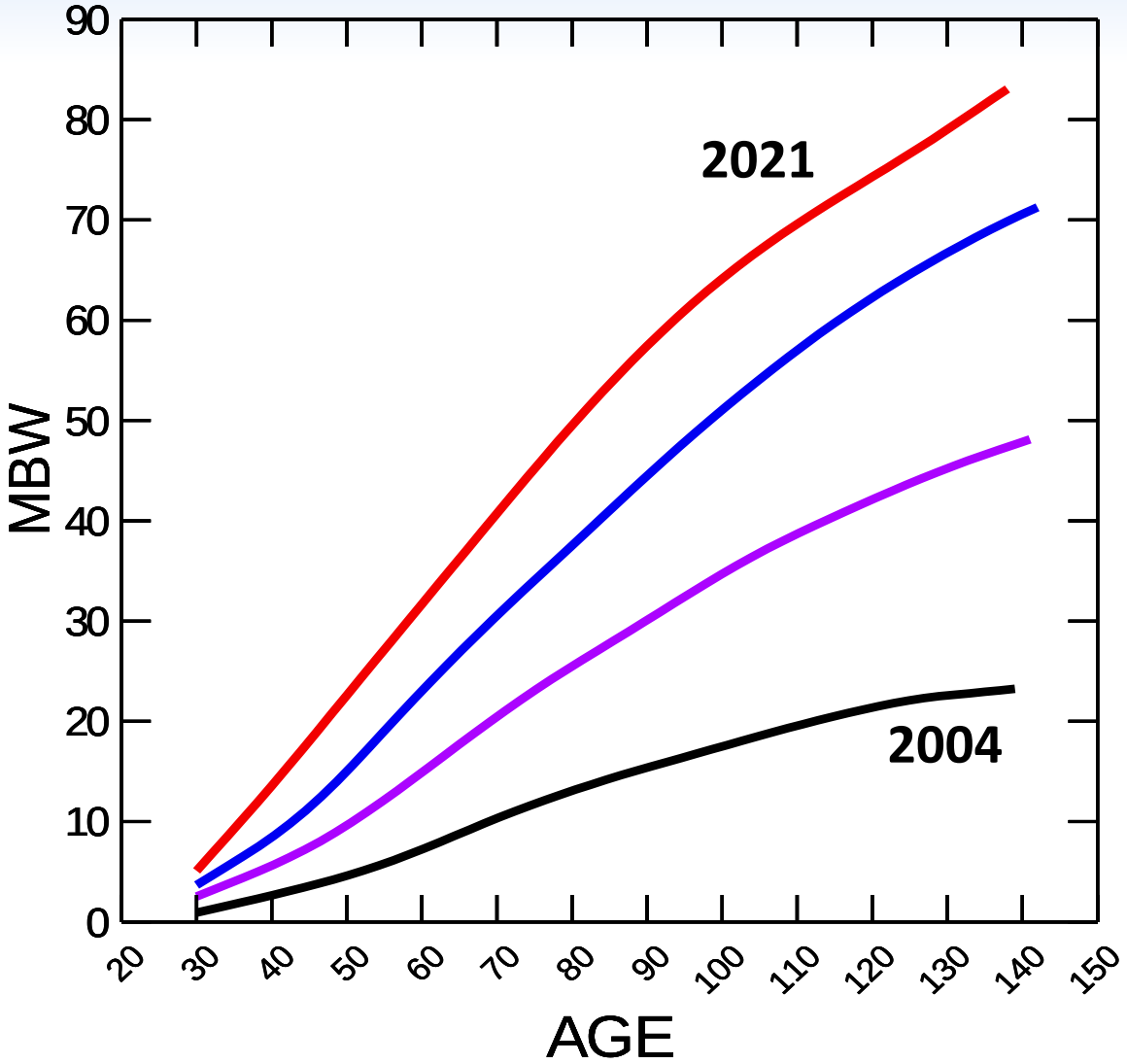
Genetic Development depends on farmer requirements

Selection Index

	2005	2010	2013	2022	2023	2024
Growth	30	60	10	20	20	20
Fecundity	10	10	10	10	10	10
Pond Yield		20	30	40	30	30
TSV tolerance	60	10	0			
APHNS tolerance			50	20	20	10
Robustness					20	30
Highly Lethal Vibrio						?

Great Genetic Success Stories (CP Turbo)
Faster Growth has resulted in reduced DOC

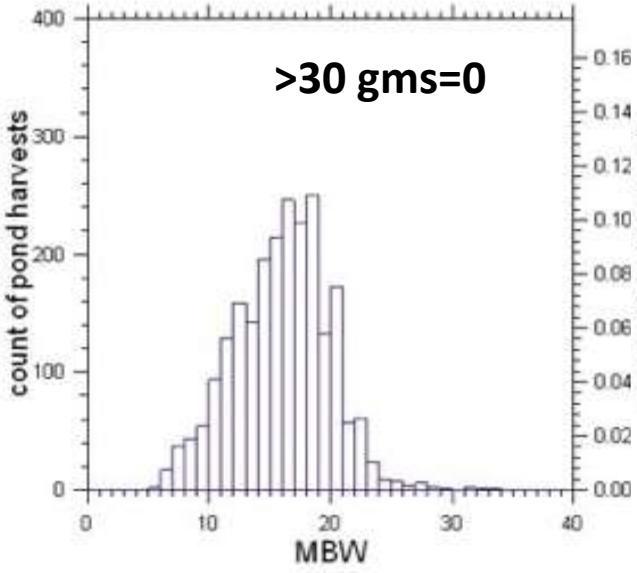
Genetic Raceway at 150/m^2



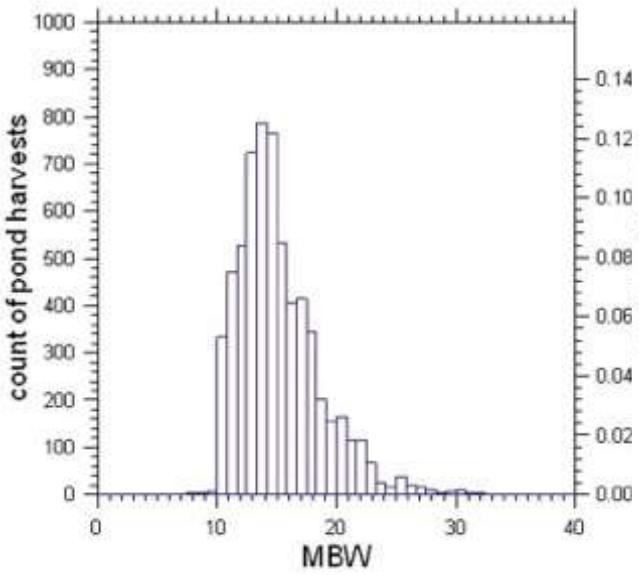
PLs grow faster and larger (pl 12)

Turbo Genetics have resulted in larger harvest size and higher values

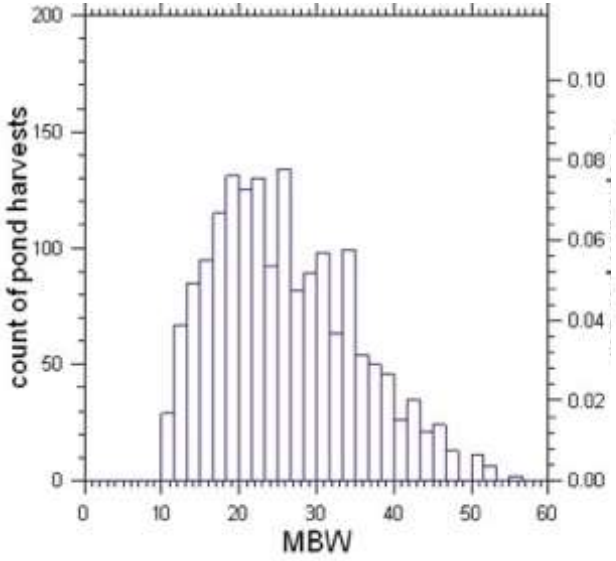
2006



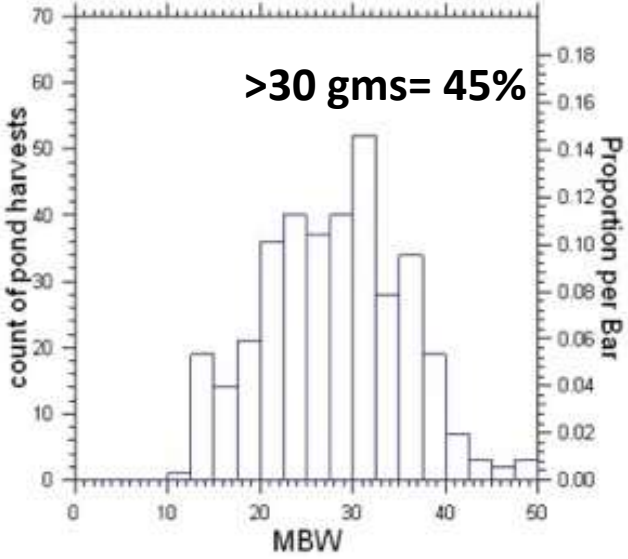
2012



2015



2021

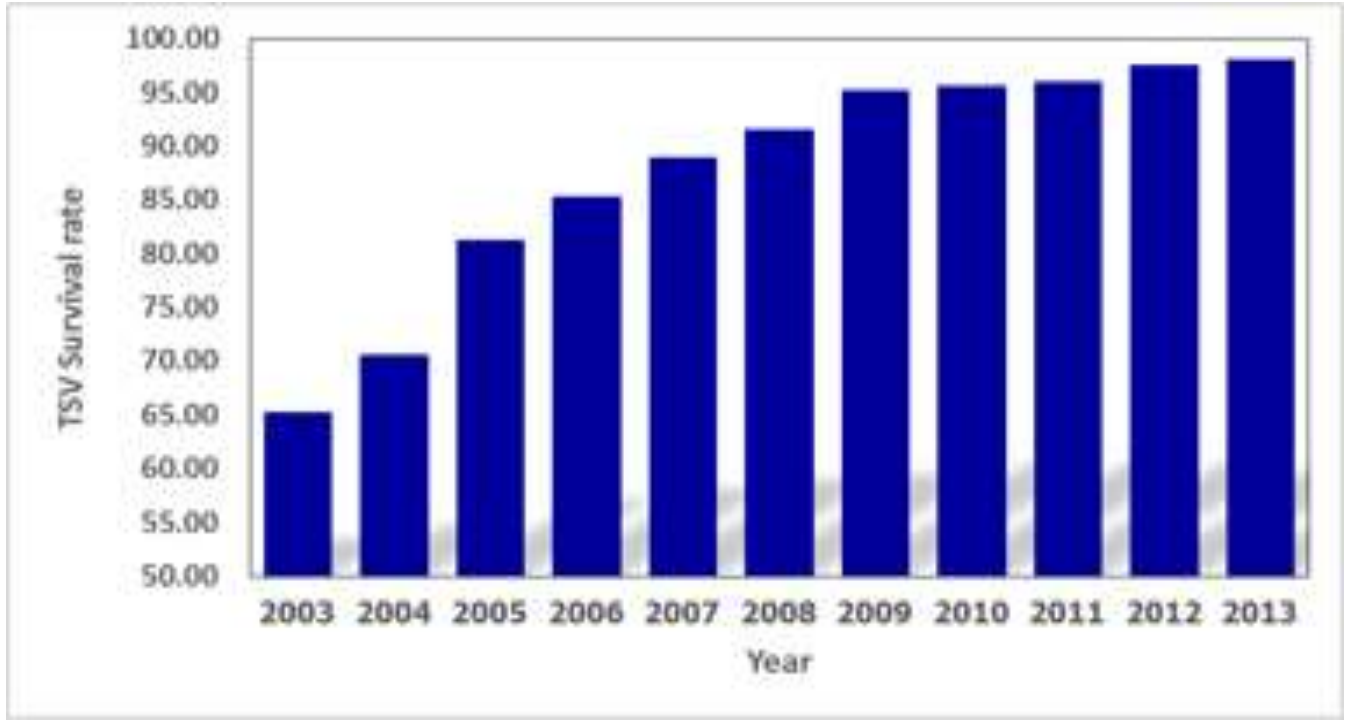


30 gms = 0 percent

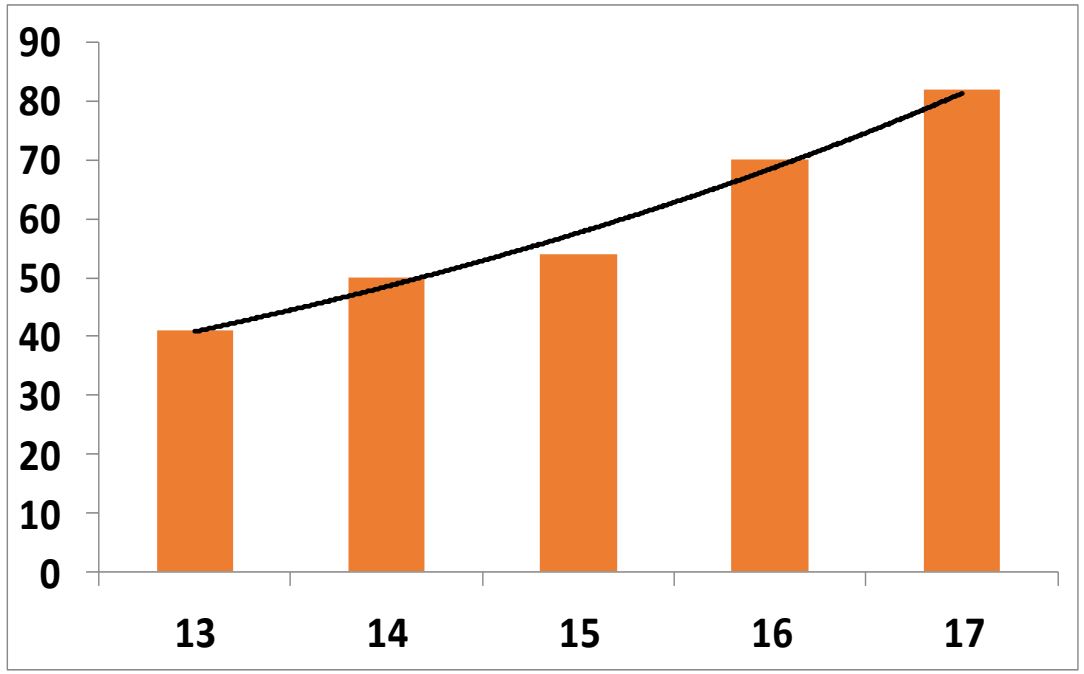
>30 gms = 45 percent

Disease Tolerance has been developed in Turbo

TSV



AHPND



Beginning Development of Tolerance:

Glass Shrimp: Vibrio Parahaemolyticus with two powerful endo toxins

Serious Issue today in China and Vietnam

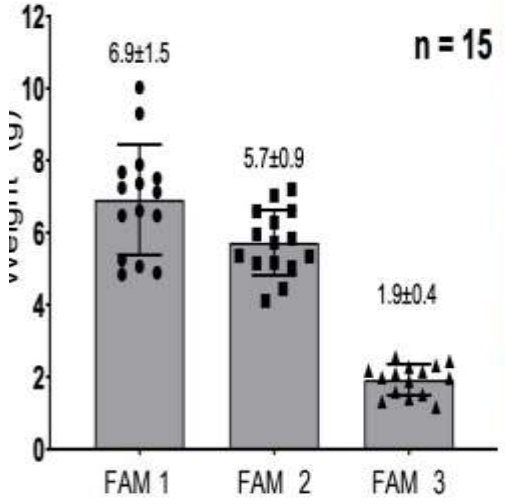
Warning of new disease appearing on white leg shrimp

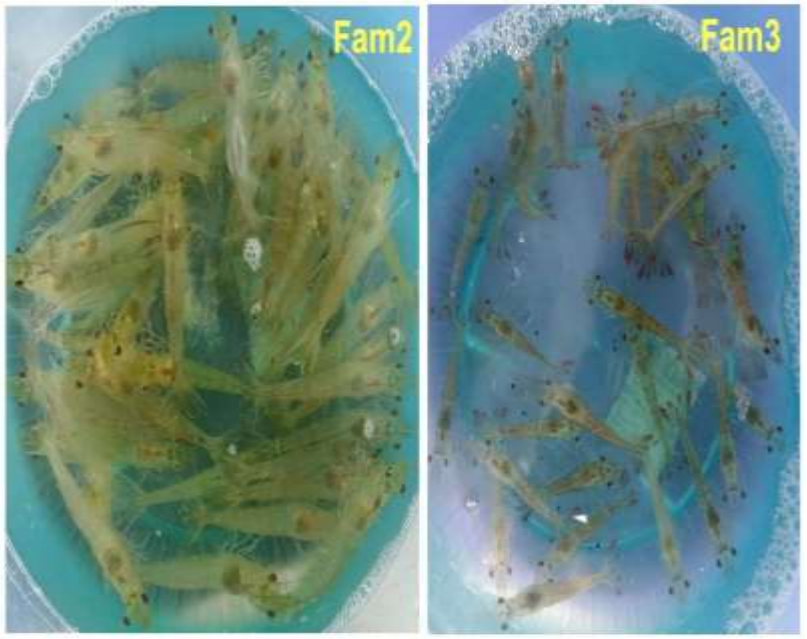
(VAN) Translucent post-larva disease (TPD) is a new disease that often infects shrimp larvae, causing high mortality, especially from PL4 - PL7.

Highly lethal *Vibrio parahaemolyticus* strains cause acute mortality in *Penaeus vannamei* post-larvae

EHP Tolerance Marker in Development

Comparison of 3 families





Contrasting tolerant and non tolerant

Shrimp no.	EHP copies/ng DNA		
	Fam 1	Fam 2	Fam 3
1	1.48E+03	0.00E+00	1.23E+04
2	1.94E+03	4.45E+00	1.85E+04
3	4.59E+03	5.99E+00	2.22E+04
4	5.15E+03	9.28E+00	2.37E+04
5	6.60E+03	9.38E+00	3.10E+04
6	7.20E+03	1.37E+01	3.35E+04
7	7.86E+03	1.37E+01	3.76E+04
8	8.42E+03	2.11E+01	3.94E+04
9	8.59E+03	2.61E+01	4.10E+04
10	1.20E+04	2.64E+01	4.53E+04
11	1.31E+04	1.70E+02	6.35E+04
12	1.63E+04	1.75E+02	6.99E+04
13	1.88E+04	2.50E+02	8.07E+04
14	1.92E+04	4.16E+02	9.95E+04
15	2.10E+04	5.46E+02	1.05E+05

Shrimp no.	EHP copies/ng DNA		
	Fam 1	Fam 2	Fam 3
16	2.14E+04	6.05E+02	1.21E+05
17	2.38E+04	8.51E+02	1.29E+05
18	2.97E+04	8.73E+02	1.47E+05
19	3.09E+04	1.02E+03	1.47E+05
20	3.12E+04	1.08E+03	1.57E+05
21	3.34E+04	1.42E+03	1.74E+05
22	3.60E+04	1.99E+03	1.84E+05
23	4.30E+04	3.42E+03	1.96E+05
24	4.38E+04	3.95E+03	3.05E+05
25	4.46E+04	1.59E+04	3.08E+05
26	4.61E+04	1.67E+04	3.11E+05
27	4.73E+04	1.83E+04	3.18E+05
28	5.74E+04	6.17E+04	4.97E+05
29	6.56E+04	2.41E+05	5.30E+05
30	2.25E+05	3.90E+05	6.16E+05

Turbo is not just growth: but fast growth in a Balanced Line

CP Turbo

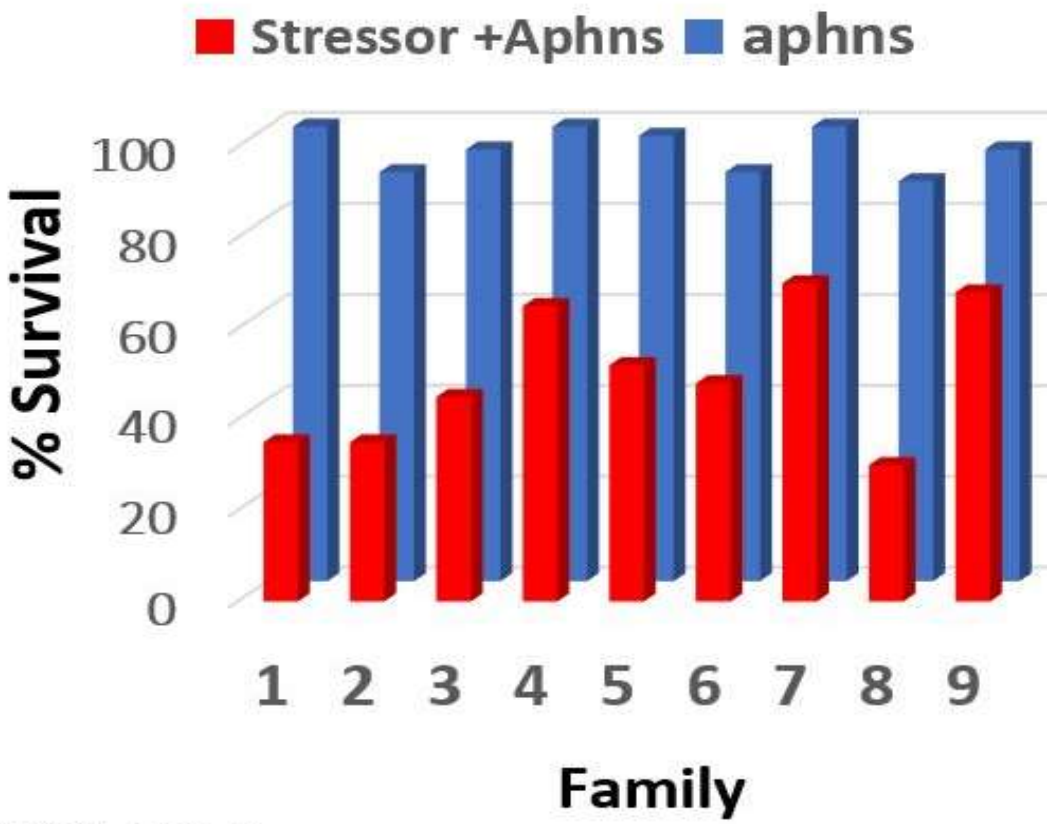
- Improved survival rate from EMS/AHPND
- Capability to grow in environment fluctuated condition to large size
- Require good bio security system

Turbo Requirements:

CP Turbo

- Faster Growth requires more feed : need to control stocking and or feed rates
- Faster Growth require more oxygen: to remain healthy DO over 5.5
- Biosecurity for WSSV and EHP
- Reduced Stress--

Appropriate Management reduces stress; And Results is highest survival



APHNS 10x4

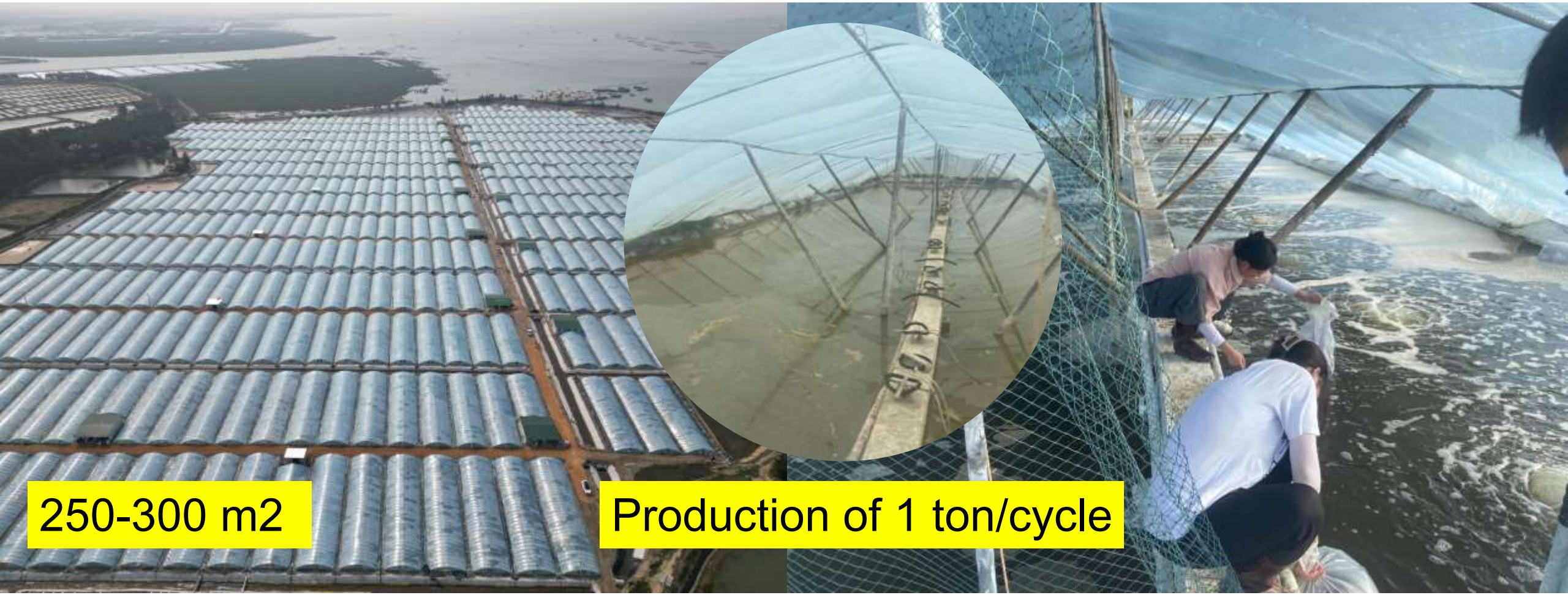
Stressor= 20 ppm NO2

Minimize STRESSES:
Low oxygen
Nitrites
pH fluctuation
Temperature fluctuation
Sulfides
High C02
Toxicity
Nutrient deficiency

Presence of Pathogens do not mean Disease!!

Ponds for CP Turbo

New Small Greenhouse Raceway China Turbo very successful: clean and fast growth



Bio-secure Tank Farms
Clean and Fast Growth Shrimp

CP KONG
WSSV tolerance with Greater Robustness

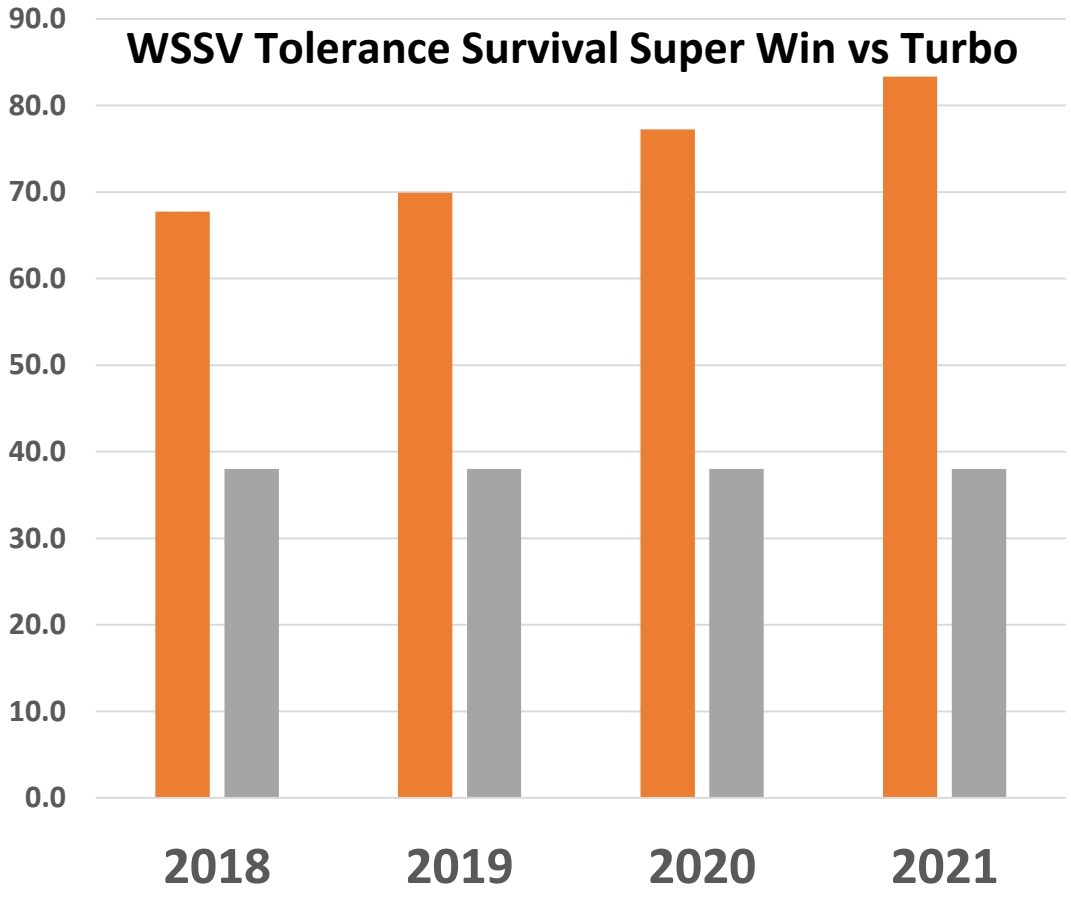
- Growth Rate: 15 gms 0.17 (85)
  30 gms 0.29 (105)

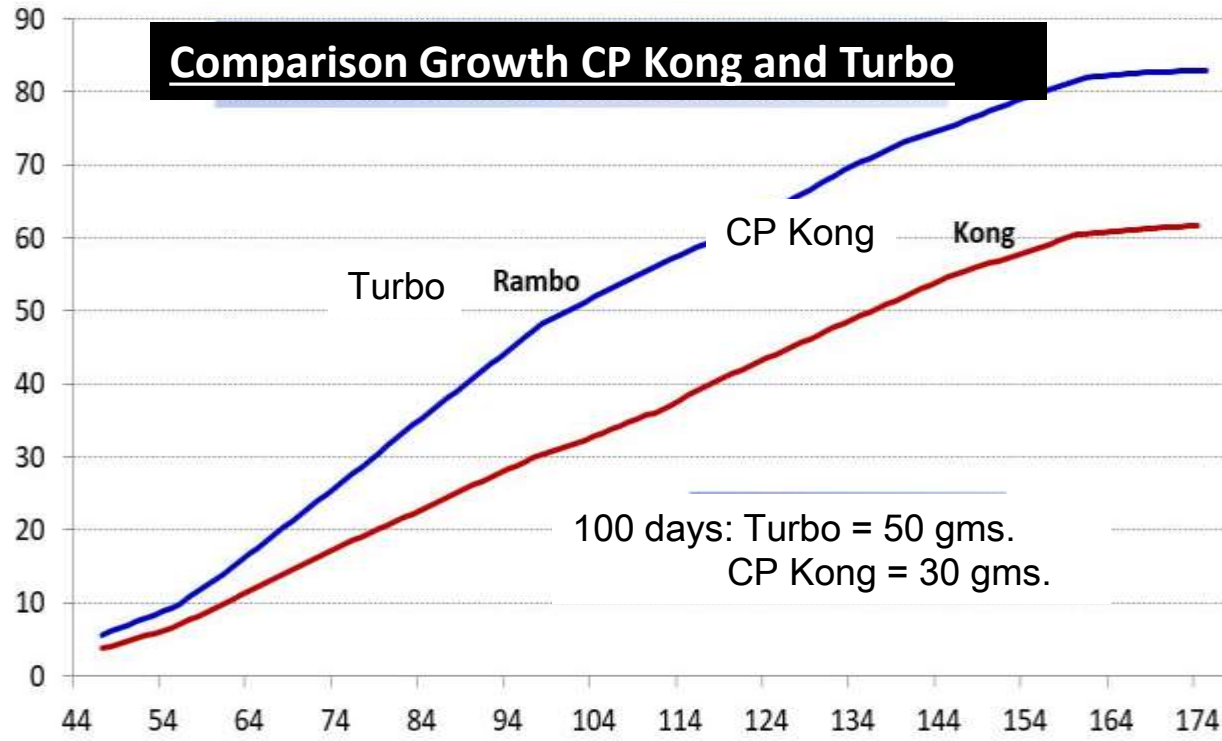
Requirements:

- Less Biosecurity and Pond controls
- Oxygen > 5.0
- Best when stocked <40/m2

Success Stories with CP Super Win

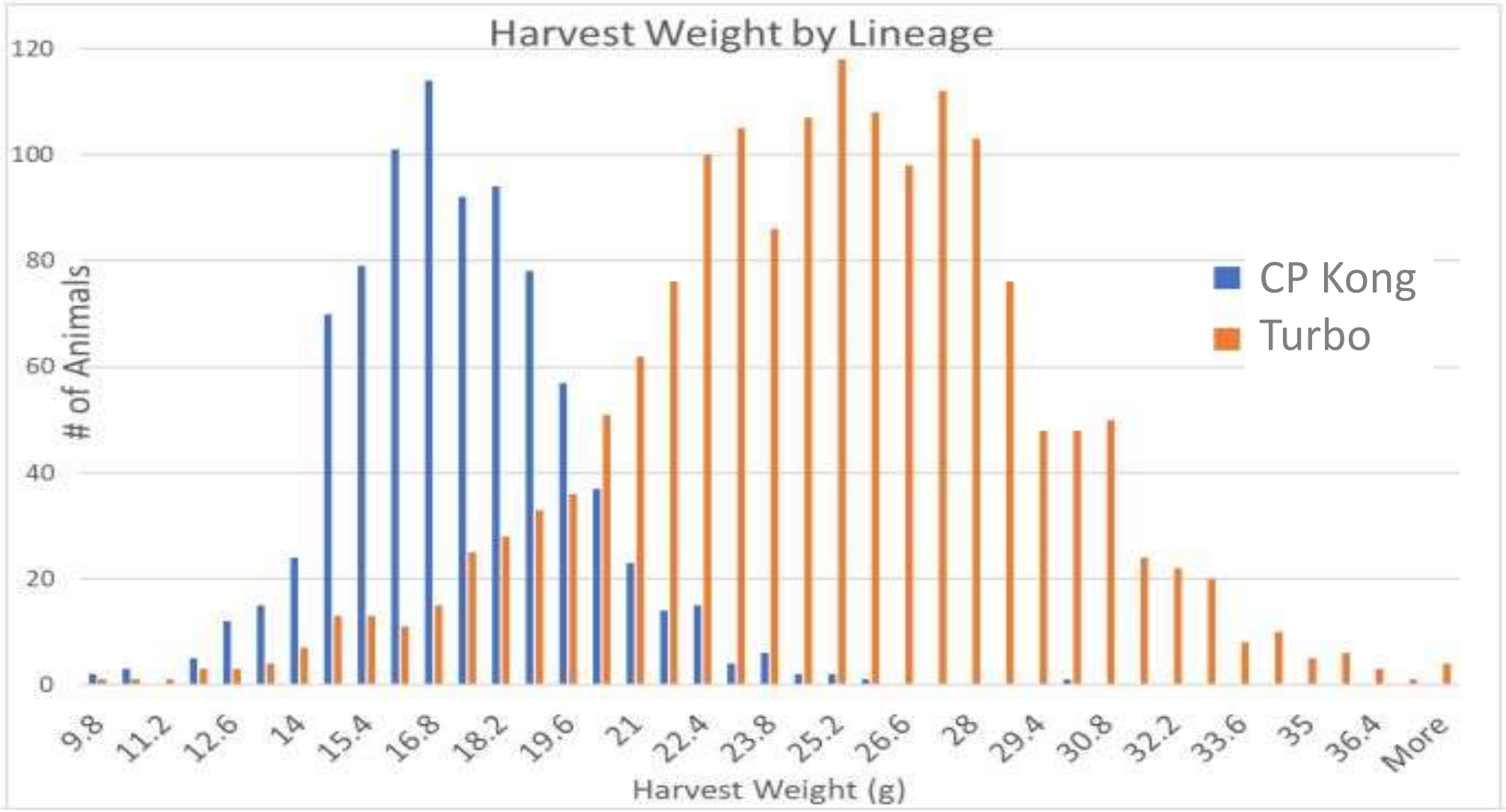
CP Kong: WSSV tolerance Tradeoff with Growth





Note; Growth of CP Kong can be same as Turbo if pond conditions are not optimized: oxygen, feed, bottoms

Results form stocking CP Kong and TURBO families in same pond (good environment/management)



Producing more Robust Shrimp :

Considerations:

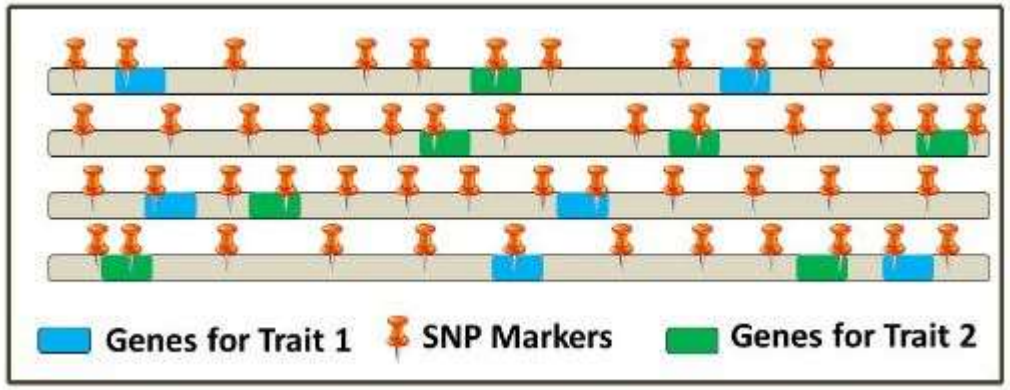
- Inbreeding
- Genetic Diversity
- Heterozygosity
- Innate Immune system

A shrimps capacity to maintain high health in adverse environmental, pond conditions

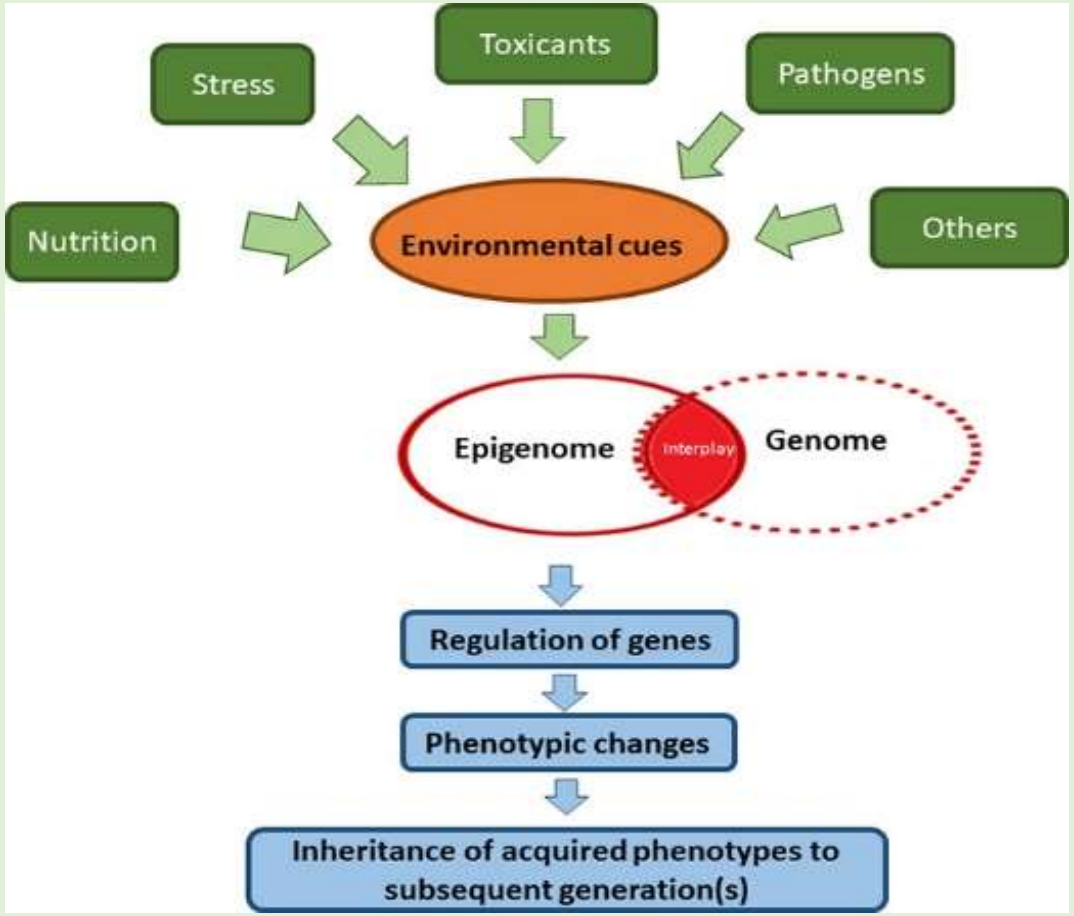
Improvements in Robustness: Mendellian Selection vs Epigenetic Manipulation)

Increase robustness through selective Genetics/ family and individuals

Classic challenge provides Inputs to develop multi trait SNP chips

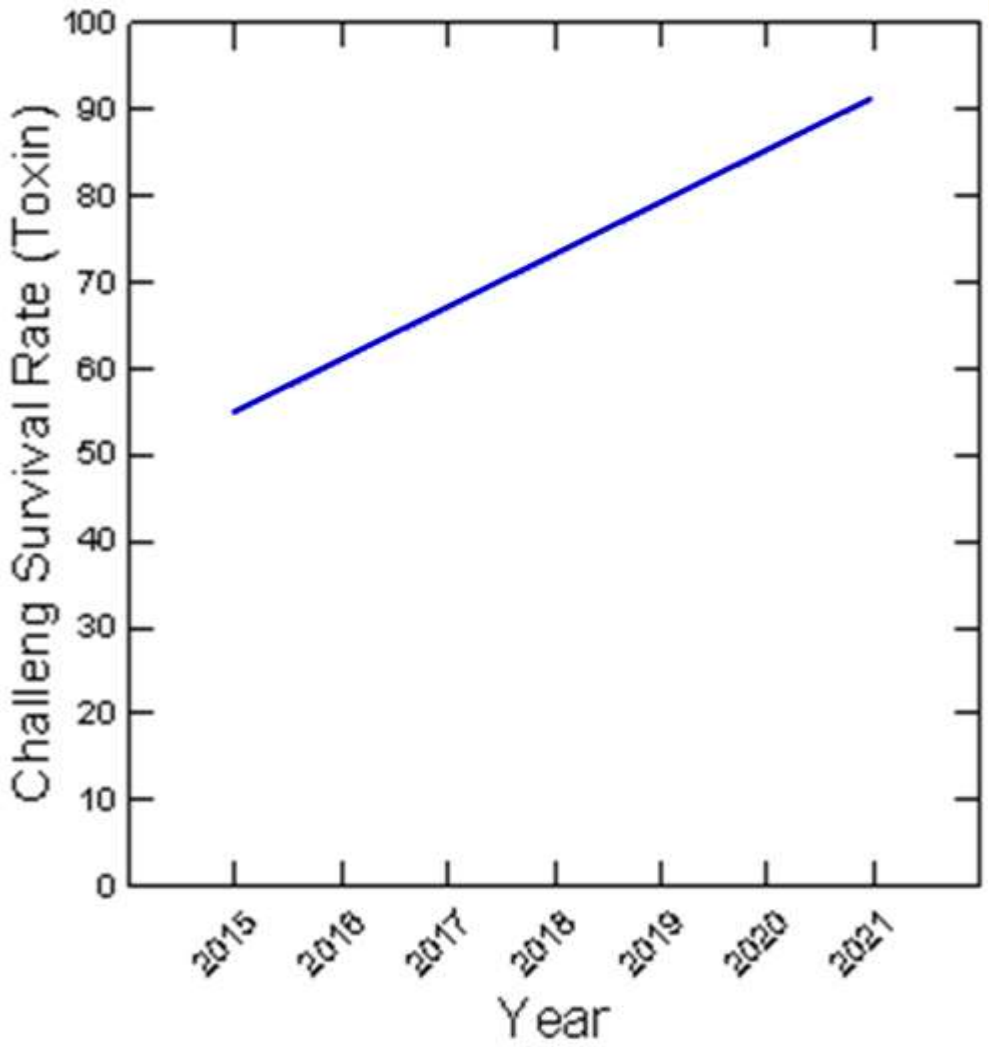


Increase tolerance through manipulation of the genome (epigenetics)



Epigenetic manipulation increases survival (robustness) of shrimp under stress

Increased tolerance to APHNS toxins over generation of selective breeding in the presence of NO_2 stress



The Gator represents CP effort to incorporate Robustness with Growth

The objectives

- Increased WSSV tolerance (molecular markers)
- Increased EHP tolerance (molecular markers)
- Increased Robustness (increased Immune Peptide Expression)
- Better Growth and survival at Higher Densities

Immune Peptide Gene Expression is Key To Maintaining Healthy Shrimp

	Low Stress	High Stress
Stocking Density	<140/m2	>140/m2
Max Feed Rate	500 kg/ha/day	>950 kg/ha/day
EHP	Positive- NO Disease	Positive - Disease
HSP 70	X	3X
ProPo	4X	X

EHP and Vibriosis have become a serious Issue on Farms due to Stress

Increase the Resting levels of Immune peptides

	Turbo	Turbo +
LvPro Po	Base	+400%
Lv Crustin	Base	+180%
Lv Pen	Base	+150%

SPF applies to Monodon as Well!!!

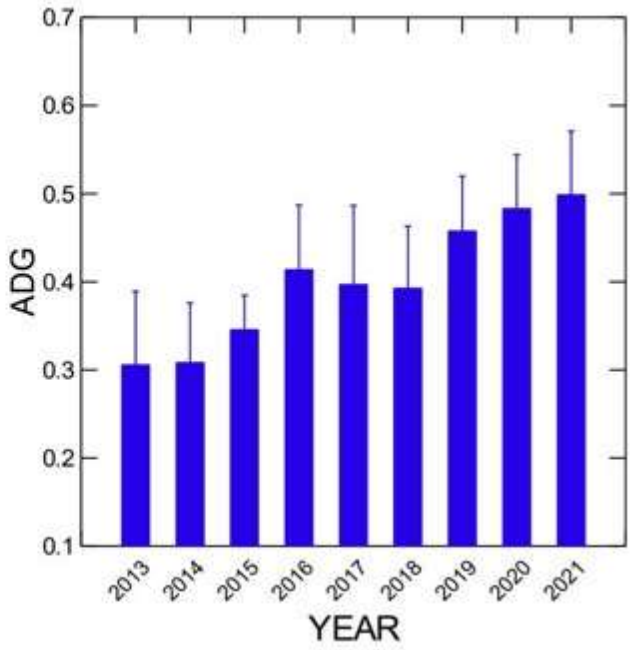
Before: 2001

After: 2011

Selective Breeding has improved the Domesticated BT– and continues to Improve

Genetic Program Improvements

Monodon RW ADG		
Year	ADG	SR
2010	0.30	81.73
2011	0.29	88.03
2012	0.32	91.45
2013	0.31	82.86
2014	0.31	87.28
2015	0.35	87.64
2016	0.41	91.87
2017	0.40	92.15
2018	0.39	88.72
2019	0.46	92.21
2020	0.48	95.21
2021	0.50	93.47



Farm Performance: Thailand

Pond	Stock density/m2	Yield	MBW	ADG	SR%
1	18	11,200	38.5	0.39	>100
2	20	11,200	49.6	0.39	84
3	18	11,400	47.6	0.39	89
4	27	10,400	55.5	0.44	50
5	18	11,600	47.8	0.36	91
6	20	7,950	35.5	0.28	82
7	25	11,600	35.7	0.27	89
8	26	13,500	29.5	0.25	>100

BT Success in Thailand

Harvest of 45 gram SPF BT in 115 days (2020, Meklong CPF Farm)

Harvest of 41 gram SPF BT in 117 days, 11 Tons/hectare, 2020 Rayong

IMPRESSIVE RESULTS FROM CHINA

EXTENSIVE: 15/M2

Item	Culturing Performance
Culturing Area(ha)	10
Stocking density/m2	15
1st Harvest size(pcs/kg)	36 (120 days)
2nd Harvest size(pcs/kg)	6 (395 days)
SR%	80%
Yield (kg/ha)	4,000
Profit RMB/Ha	1,200,000

More Impressive Results Intensive

Item	Culturing Performance
Culturing Area(rai)	2
Stocking density /m2	65
1st Harvest size(pcs/kg)	60 (92 days)
2nd Harvest size(pcs/kg)	40 (122 days)
3rd Harvest size(pcs/kg)	30 (152 days)
SR%	90%
Yield (Kg/m2)	15,500
Profit RMB/Ha	910,000

Converting Clean Healthy Broodstock to Clean Healthy Post Larvae

Farmers do not buy Broodstock; Farmers buy Post Larvae

What defines “ A CP hatchery”

Modular	Consistent, constant production of quality spf post larvae
Disinfection	Buildings, water, pipes, airlines, tanks
Pathogen free inputs	Nauplii, algae, artemia, all feeds
Certified SPF broodstock	Ensure pathogen free stocks of all known pathogens (not just OIE)
Quality Control	Vigorous QC standards, including on site validation of being pathogen free

CP hatcheries are Modularized:

Consistent operations and production

Disinfection of Water and Air

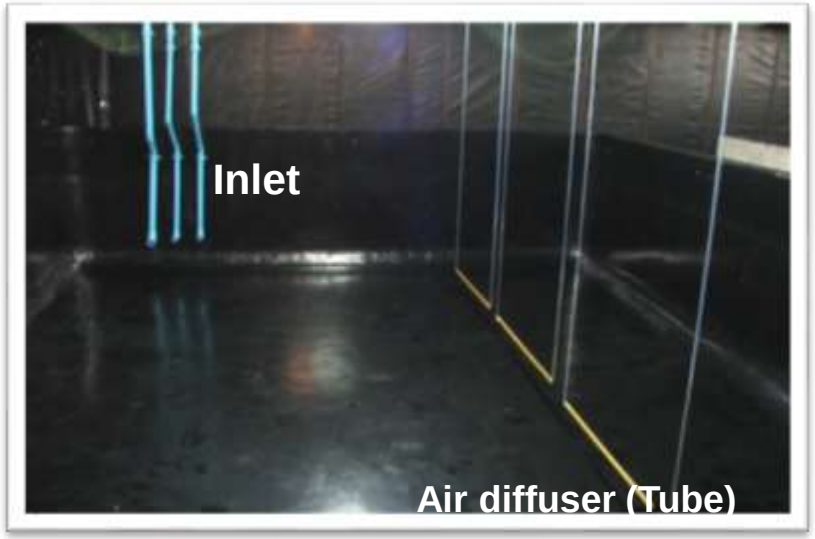




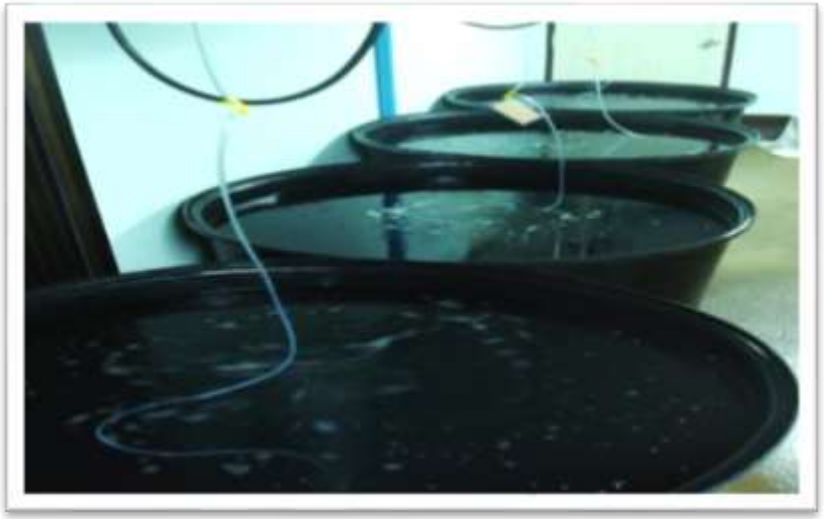
Today with the challenge of fungal and parasite spores; new cost effective technologies are required

To prevent EHP requires Ultra Filtration

Maturation is closed recirculation and monitored

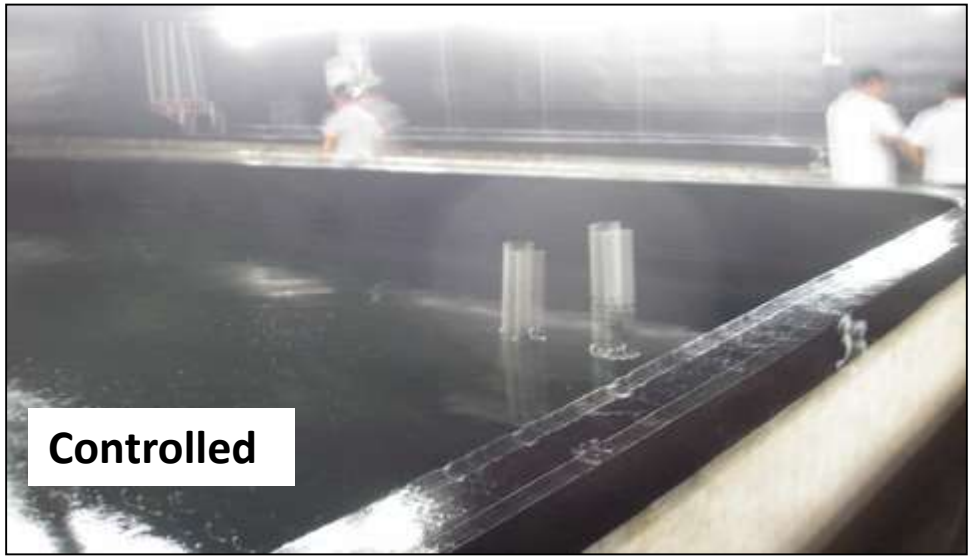


Spawning and Nauplius harvest Tank



Nauplius Tank

Maturation Operations require pathogen free feeds



EFFICIENCY= 30-45 MILLION NAUPLII/1000 FEMALES/DAY

Only Top Nauplii are collected for Stocking

Eggs sterling in spawning tank (eggs – Nauplius1)

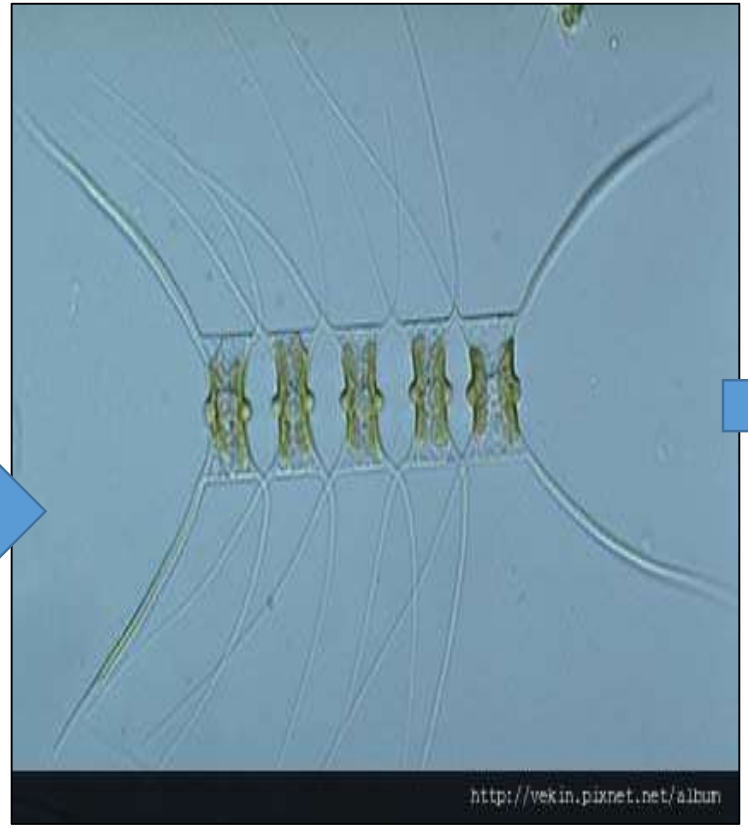
Washing nauplius1 from spawning tank to hatching tank

Stocking nauplius1 in hatching tank (Np1 – Np4)

Syphon the waste in bottom of hatching tank

CP feeds most Nutritious algae strains:

Skeletonema: **easiest**



Chaetoceros: Easy, and nutritious
Easy contaminated with Z2

Thallasossira: Most nutritious, less easy contaminated

CP hatcheries have high tech approach to algae culture- keeps cultures sanitary

Poor Mating!
Mis-placed Sperm

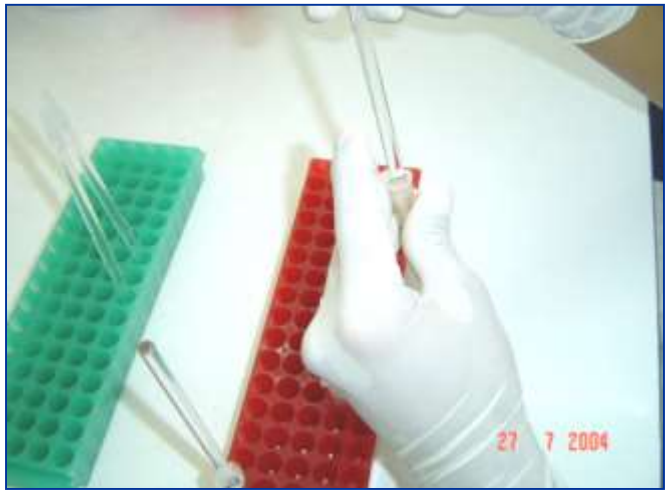
Why- Cause?

Artemia a source of Vibrio
Careful and monitored hatching, harvesting and washing

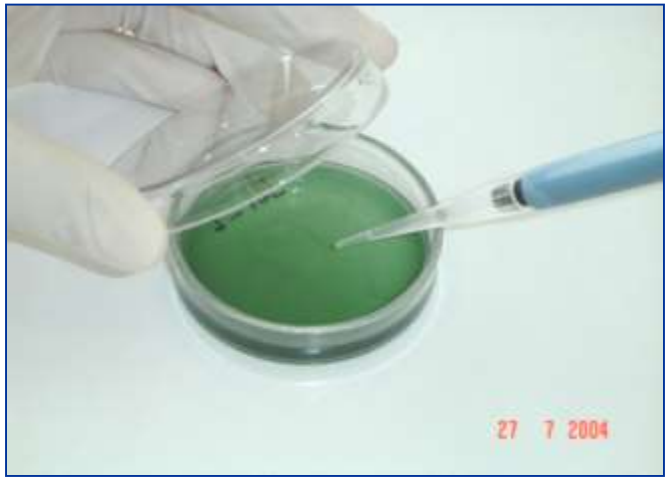
Hatcheries maintain Sanitation and Stable Environment

Vibrio Monitoring in PIs before Sale/Stocking

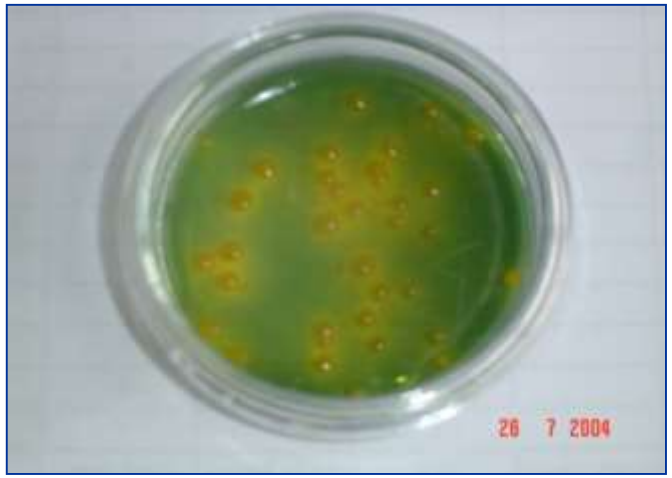
FILTED SHRIMP



GRINDING

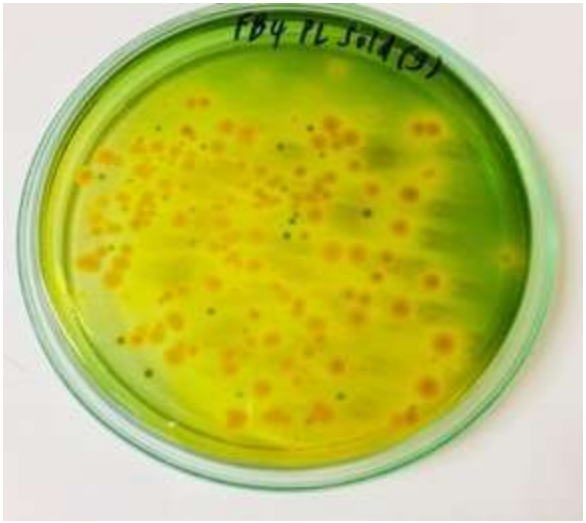


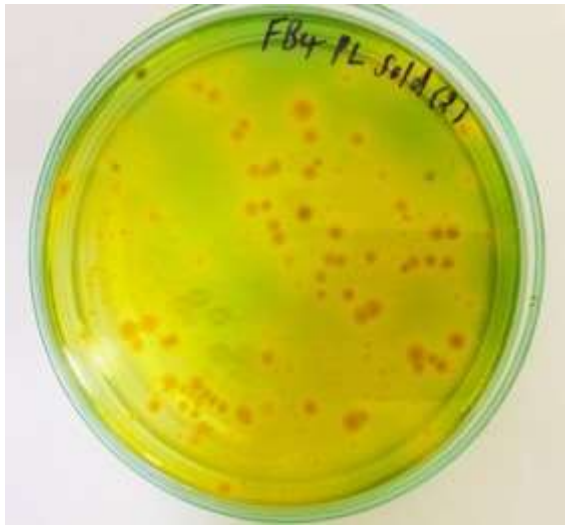
FILL IN TCBS AGAR PLATE

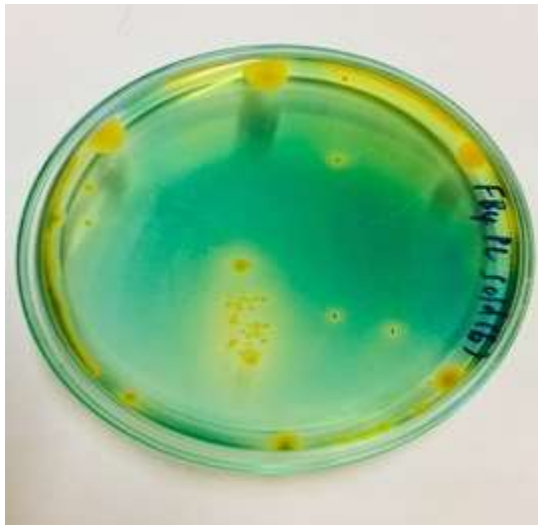


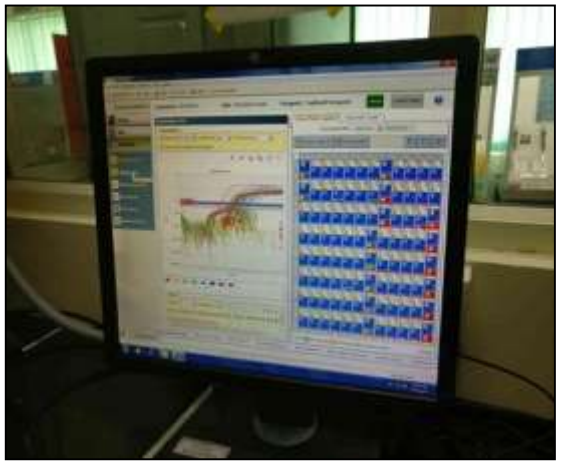
VIBRIO COLONY

All Post larvae are Screened before sale









Yellow: < 10x4/ gram of pl

Green: < 10x3

PCR essential for ensuring pl does not carry EHP

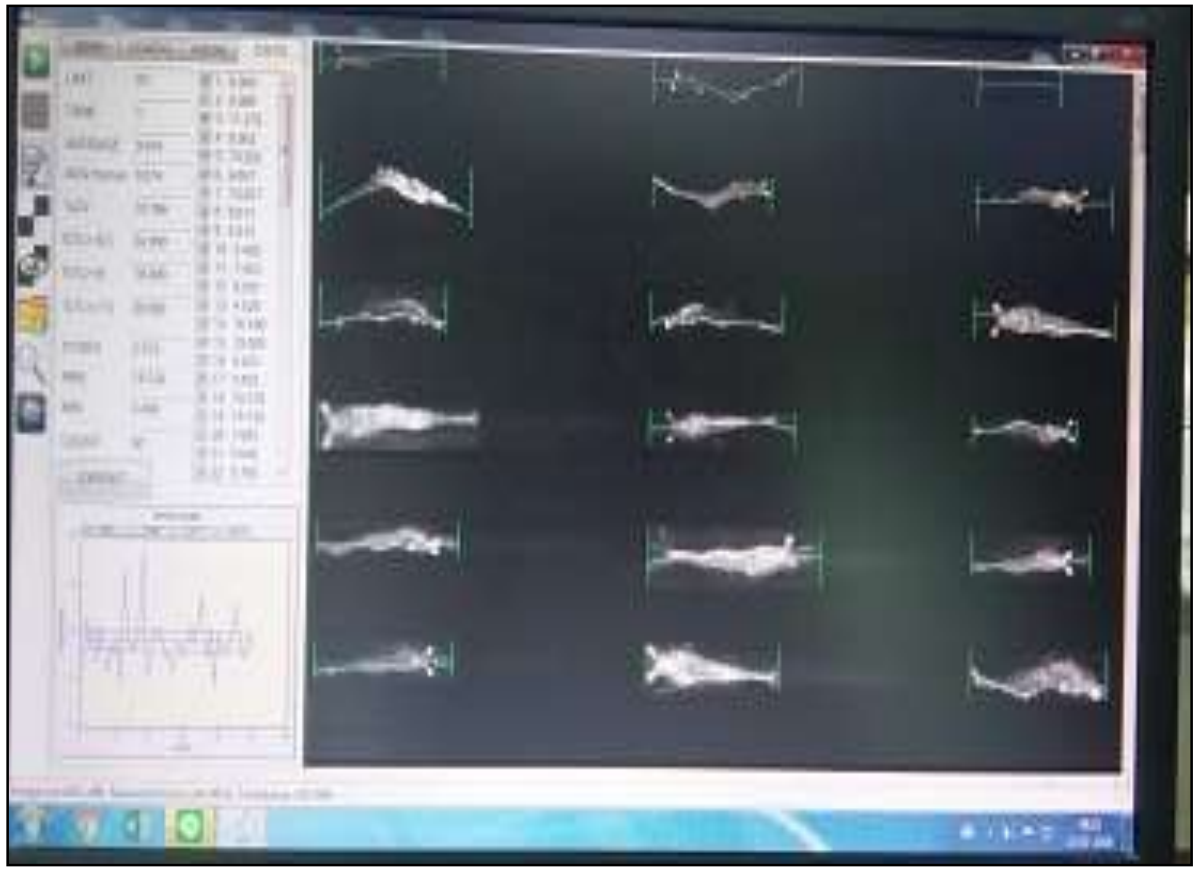
CP Hatchery PCR extraction Room

And most Important:

Hatcheries must have a discipline to maintain "**Standards**"

Factor	Parameter	Standard	
		1st Pass QC.	PL Turbo sold
1. Physical factor	Total length (mm.)	≥ 8.30 mm	>9.30 mm
	Coefficient of variance (%CV)	≤ 11%	≤ 12%
	%TL ≥ 8.30 mm	> 80%	>80%
	Number of shrimp per g.	≤ 300 pcs/g.	<250 pcs/g.
	Stree Test (Salinity test)	≥ 90%	≥ 90%
2. Biological factor	White Spot Syndrome Virus (WSSV)	Non detected (ND)	
	Infectious Hypodermal Heamatopoietic Necrosis Virus (IHHNV)	Non detected (ND)	
	Enterocytozoon Hepatopenaei (EHP)	Non detected (ND)	
	Green colony count (GVC)	< 1.00 x 10^3 CFU/g	
	Luminescent Vibrio (LB)	Non detected (ND)	

Size and Uniformity Standards!!!



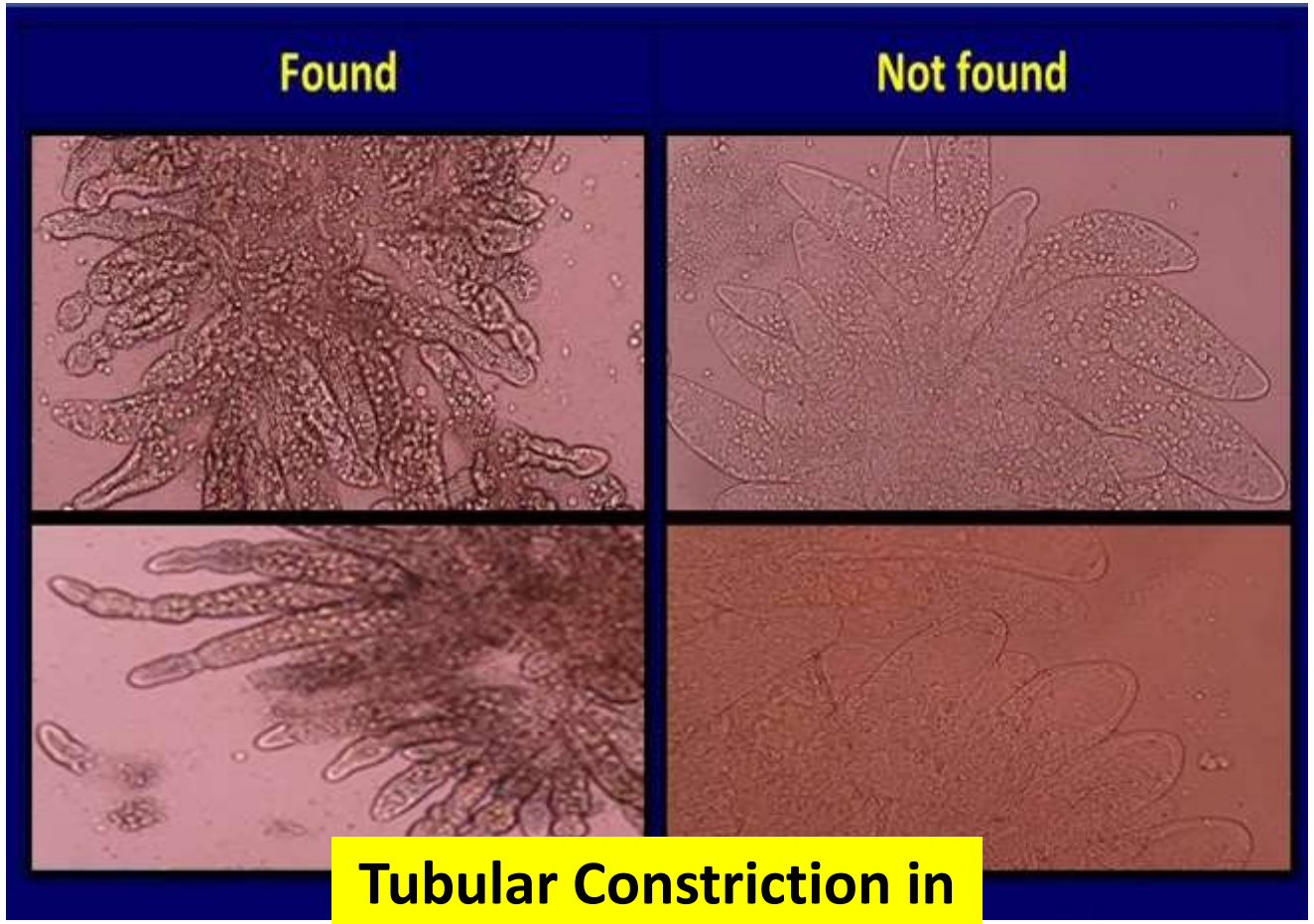
*Standard %CV at Sold : ≤12%

* Standard (PL / Grm) : < 200 pcs / grm

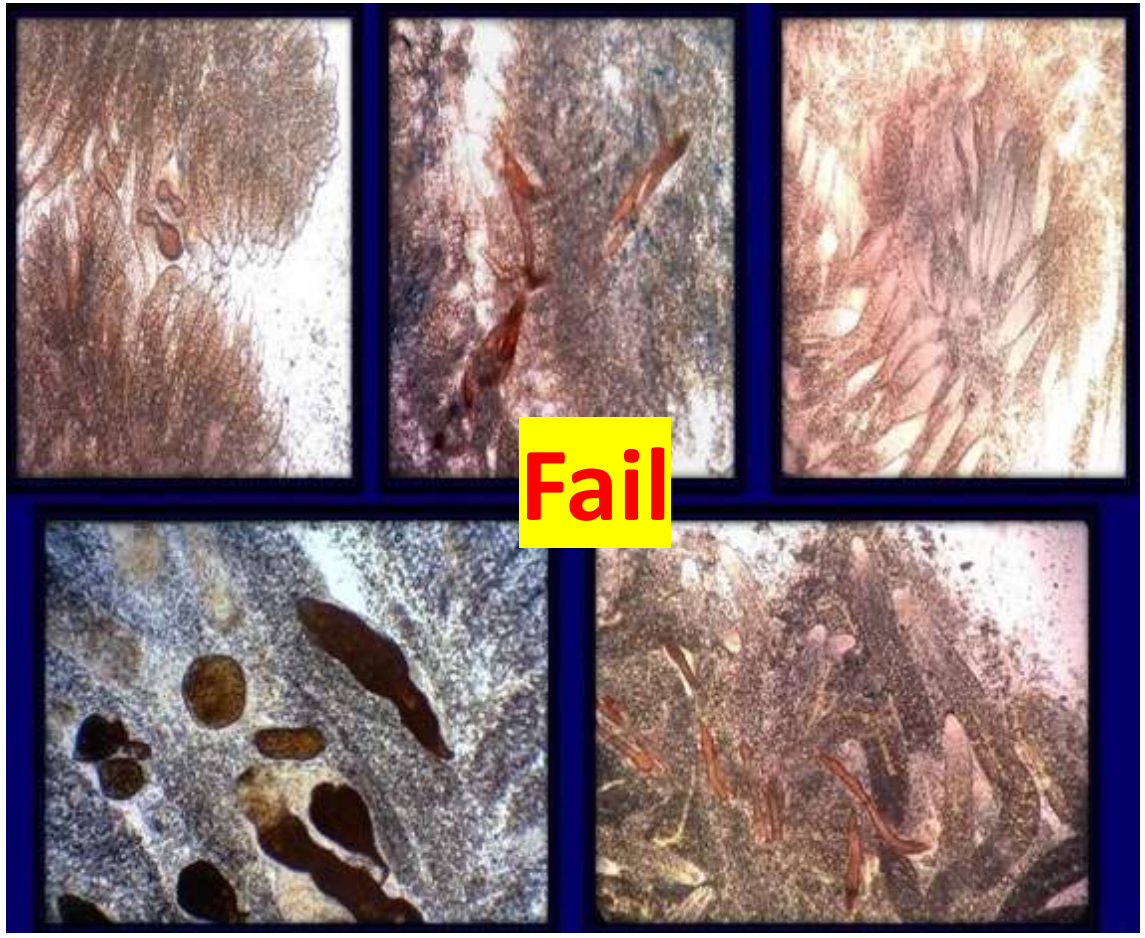
Farms can do this !!

Microscopic exams reveal much about pl health

Fail **Pass**

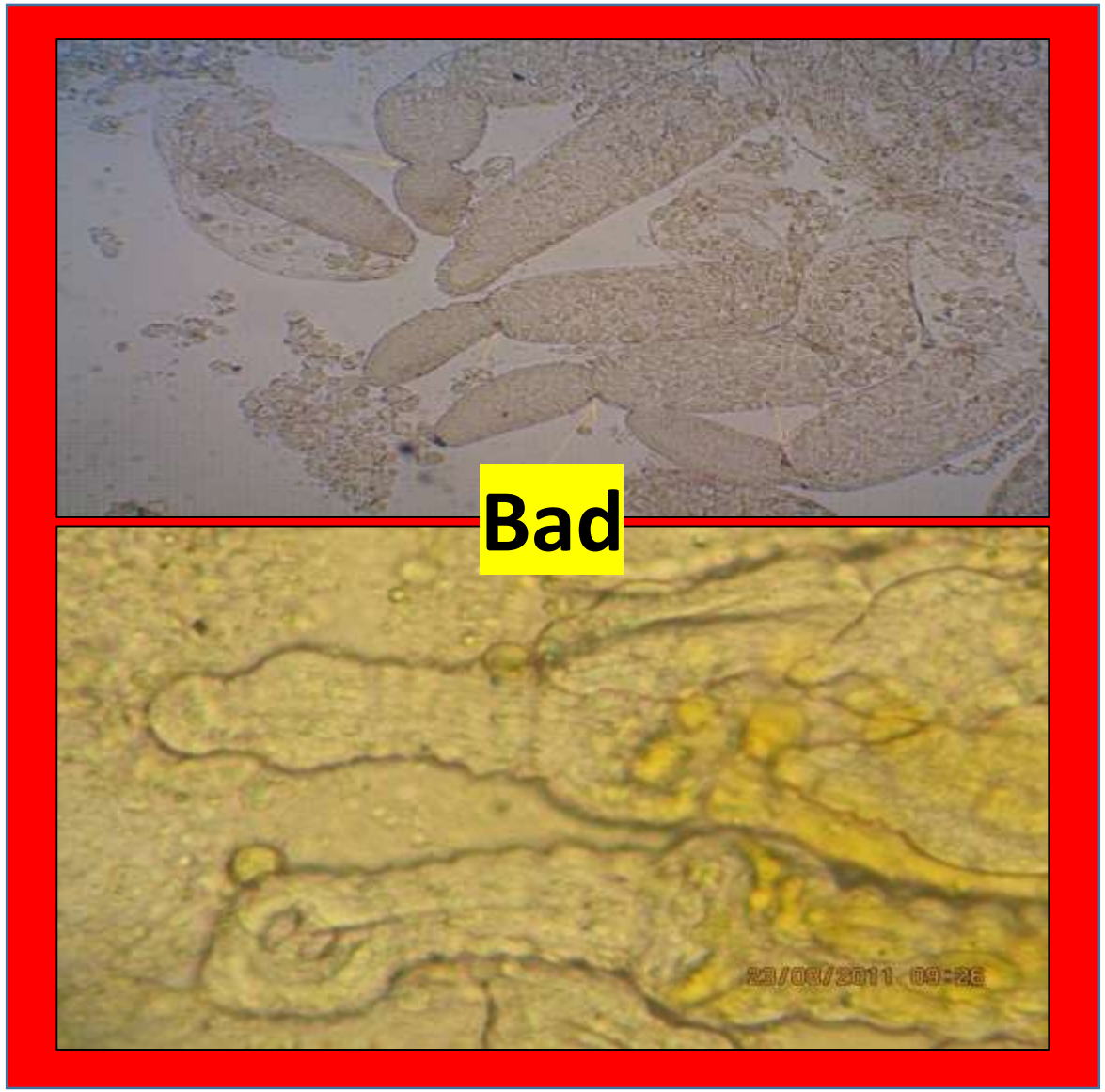


Tubular Constriction in Hepatopancreas



Melanization

CP dedicated to highest Quality



CP always healthy post larvae

The first (and most important step) in producing profits: START with disease free, Healthy Post Larvae