Shrimp Broodstock:

Importance of Genetics and Health to the development of Sustained, Profitable Shrimp Culture and Trends in World Shrimp Production

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Advanced Genetics is a tool but should not be seen as a SOLUTION

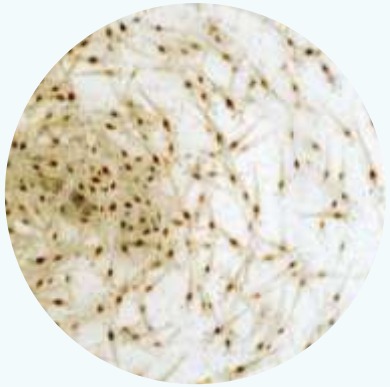
Success is not from only!!!

Shrimp Genetics

Shrimp Post larvae

Feeds

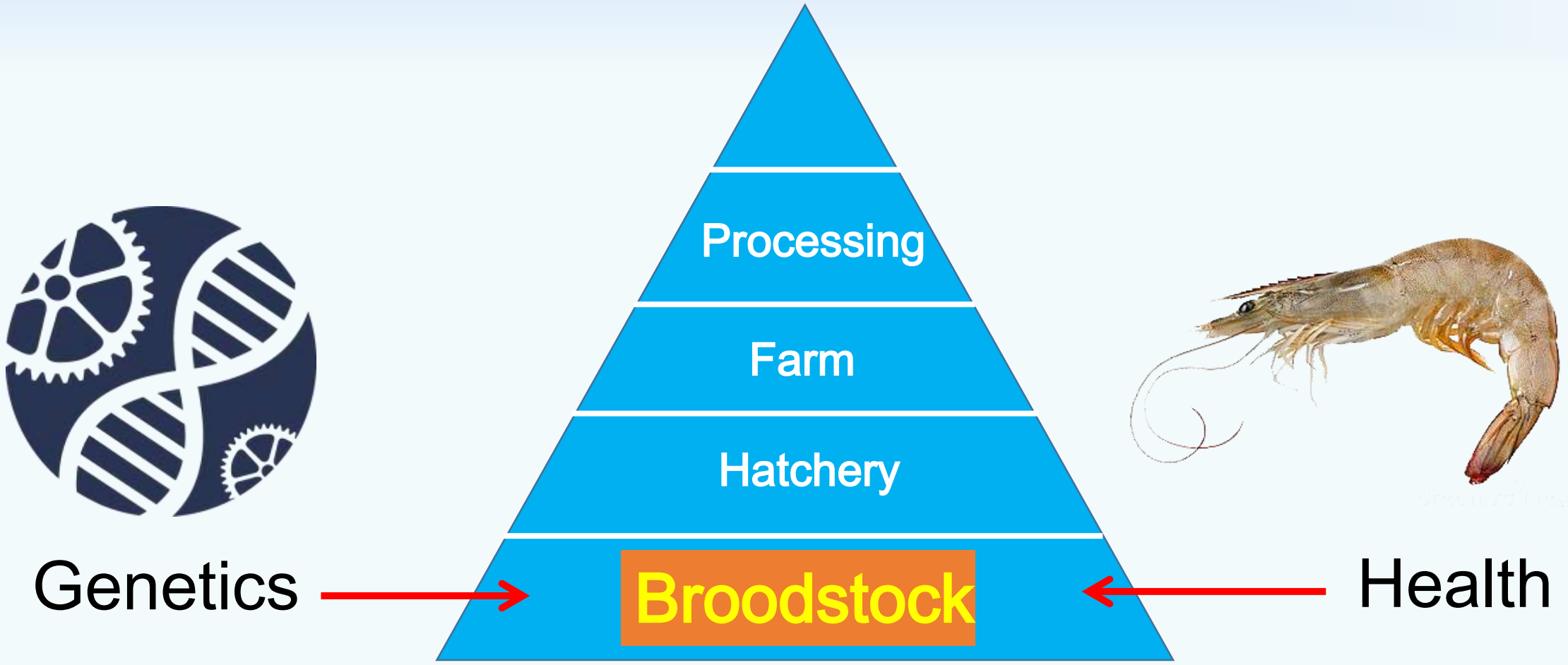
Pond Management Strategy



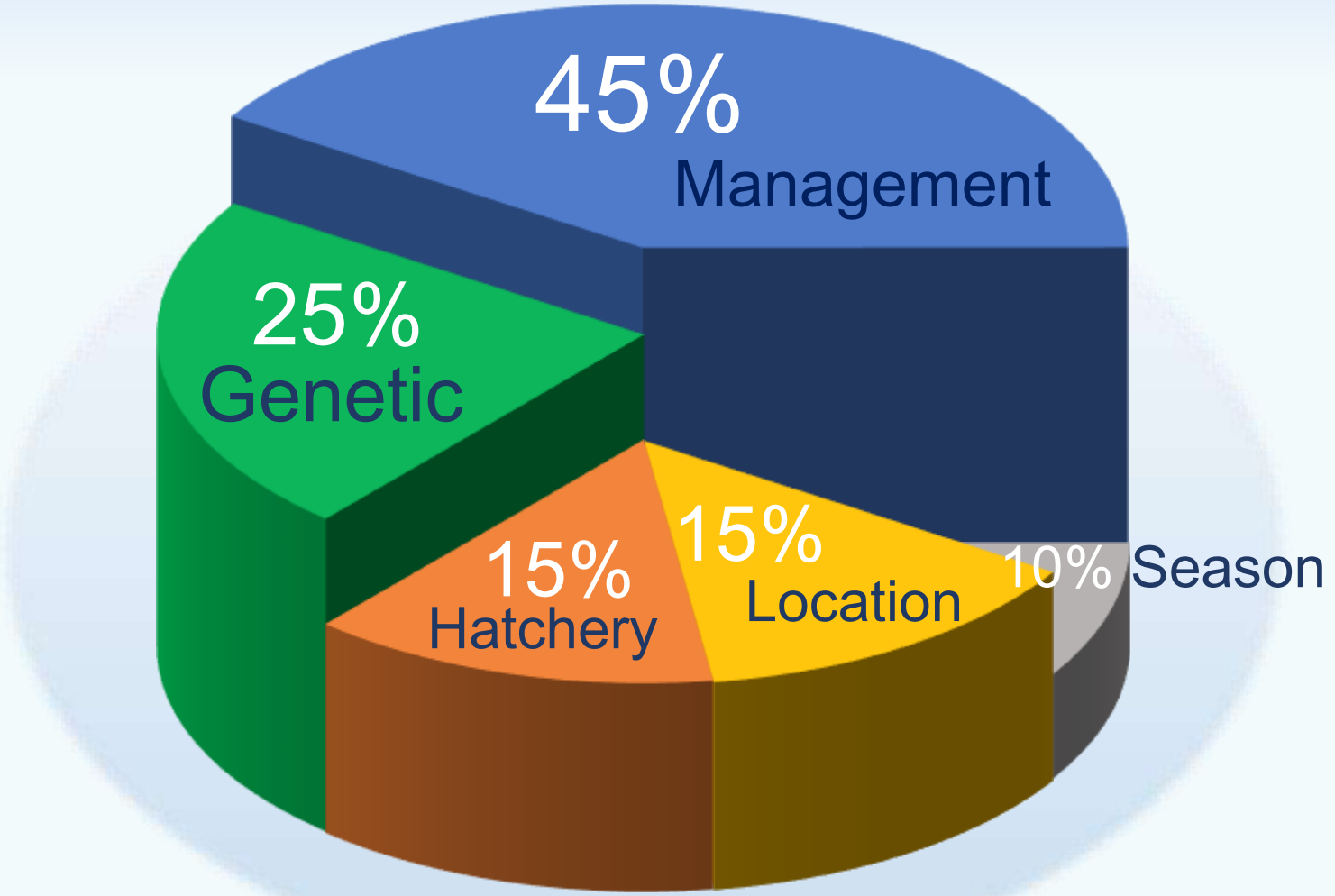
World production has continued to increase (everything seems good)

The Aquaculture Pyramid

Broodstock are the foundation of this pyramid



Important: Variable Pond Performance is more than just shrimp genetics



Healthy Post Larvae: That is what matters!

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;

APE *vs* SPF

Broodstock Health First

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

Require optimum culture conditions

Epigenetic conditioning

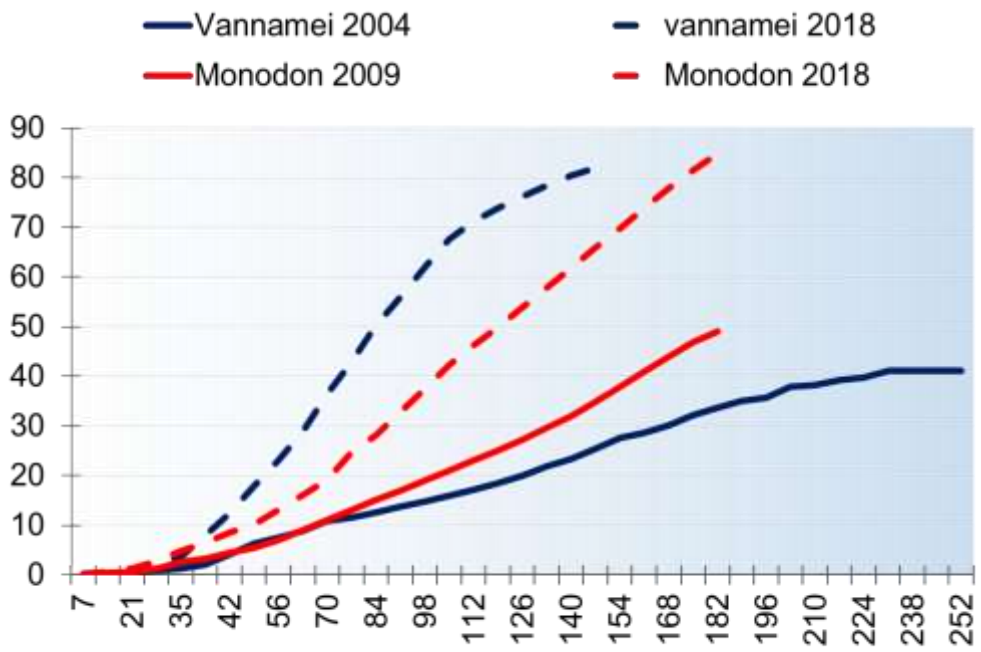
Require absolute biosecurity to maintain SPF status

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

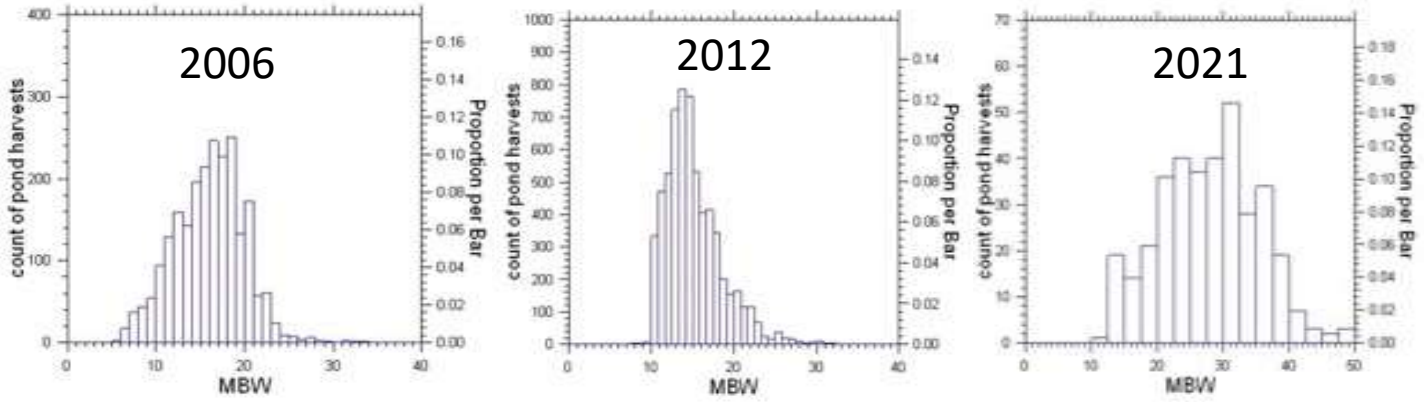
Genetics:

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

Growth



Size

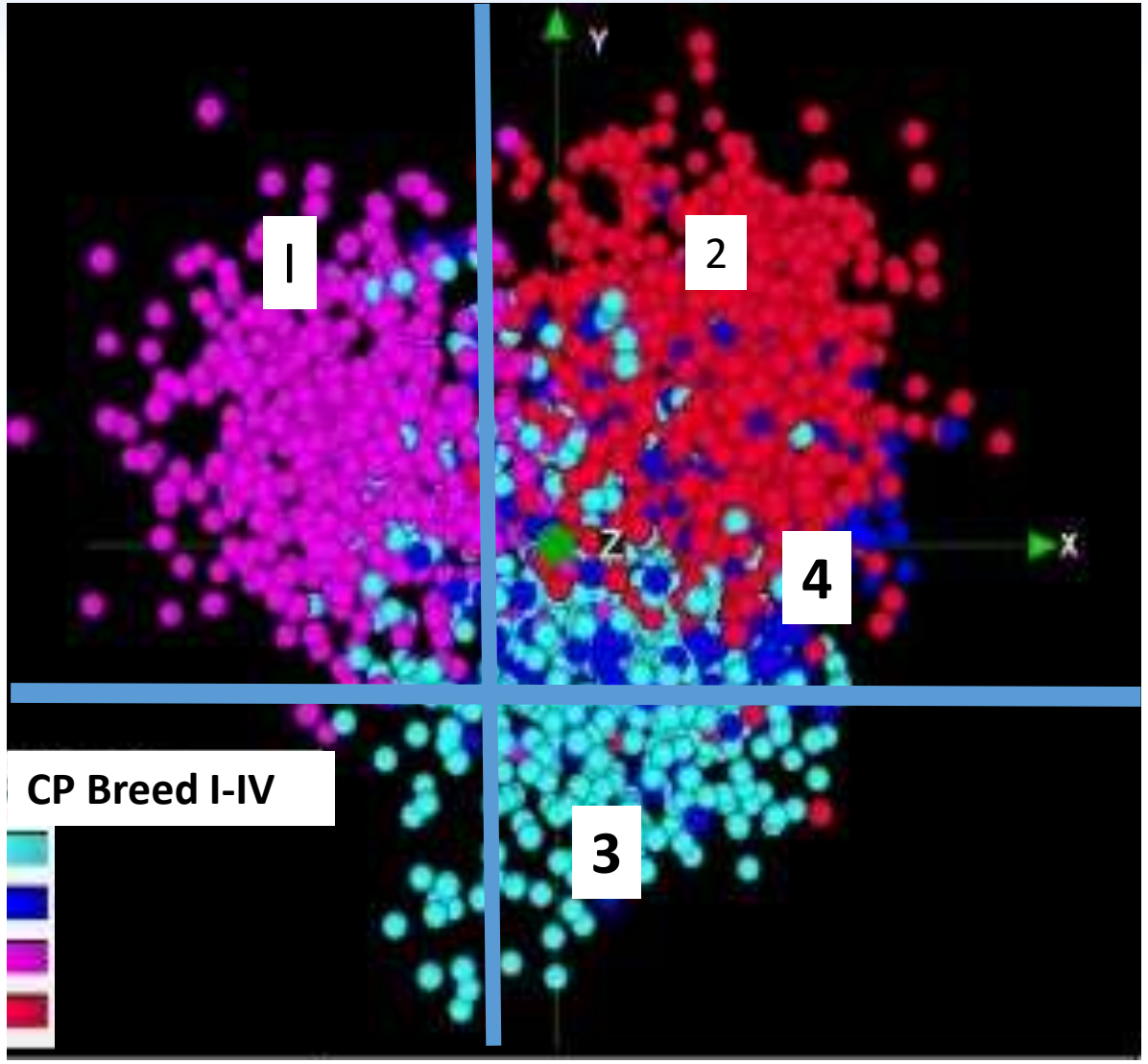


30 gms = 0 percent

>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 Thailand

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						?

Maybe the Next Disease we must create tolerance too:

Glass Shrimp: Vibrio Parahaemolyticus with two powerful endo toxins

Serious Issue today in China and Vietnam

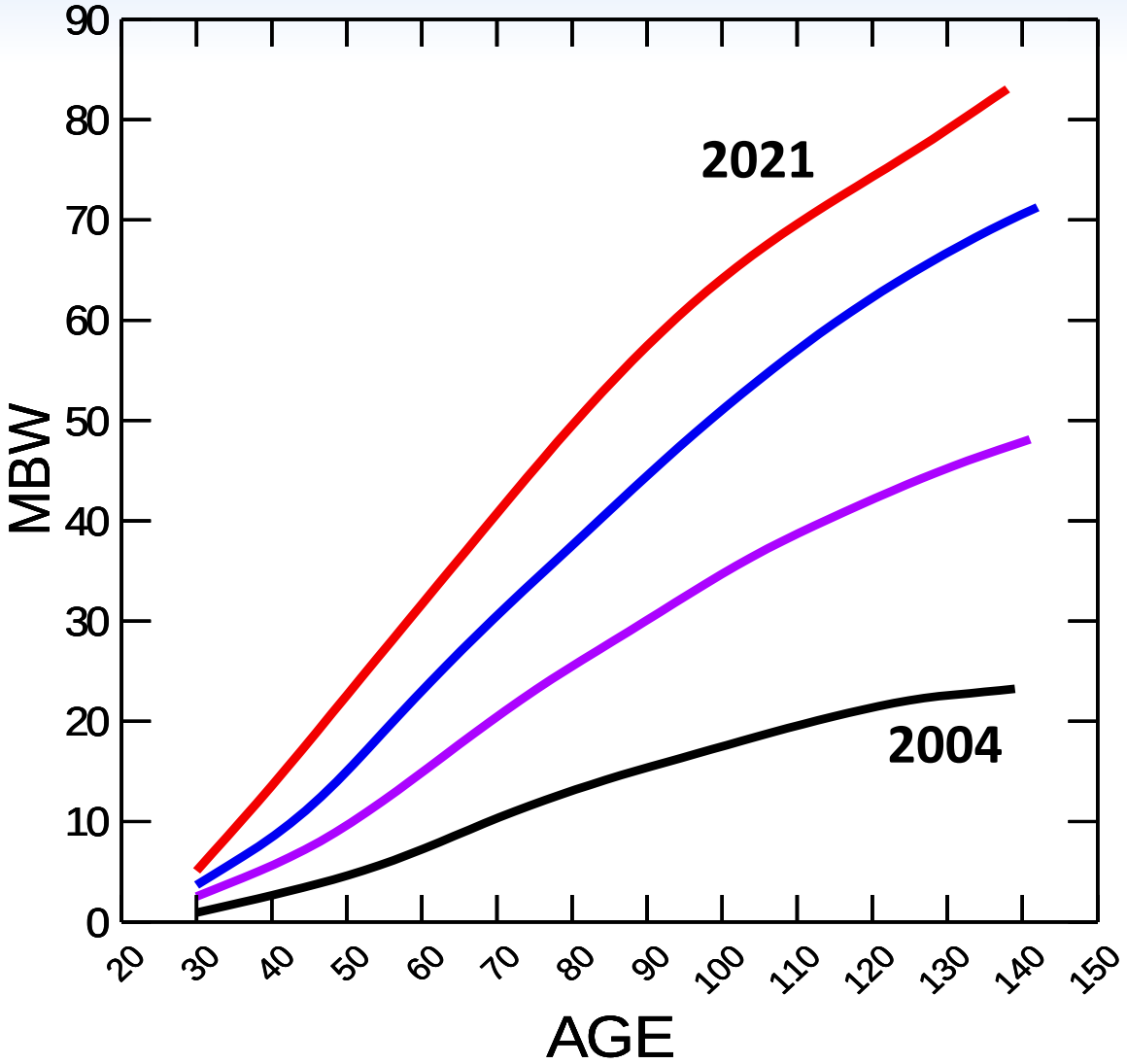
Warning of new disease appearing on white leg shrimp

(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

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

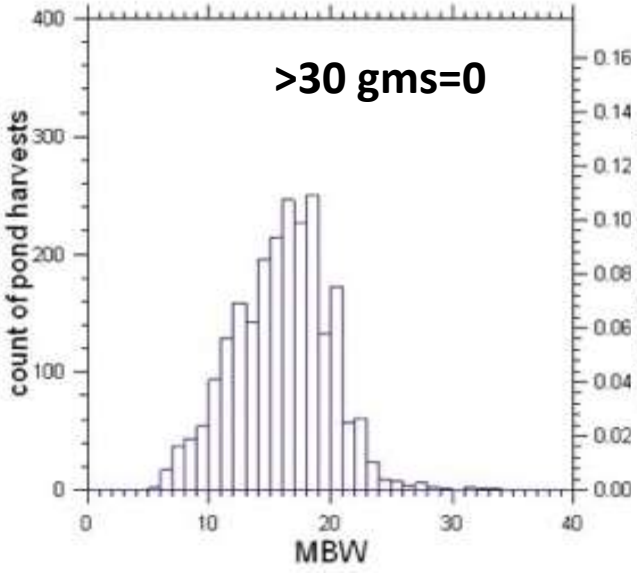
Genetic Raceway at 150/m^2



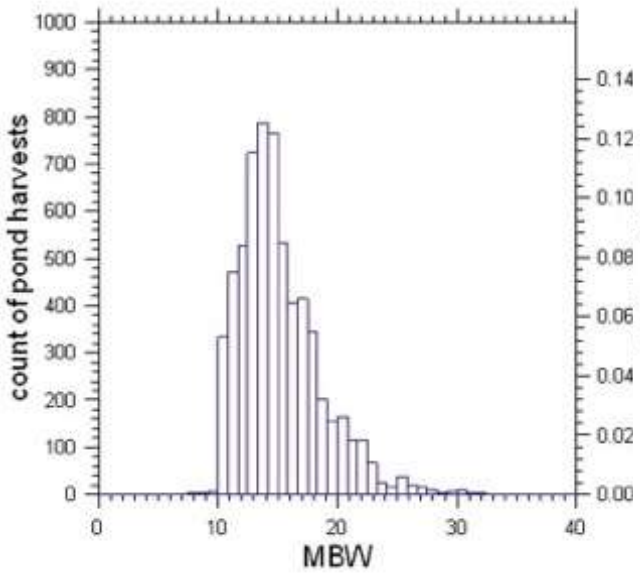
PLs grow faster and larger (pl 12)

Turbo Genetics have resulted in larger harvest size and higher values

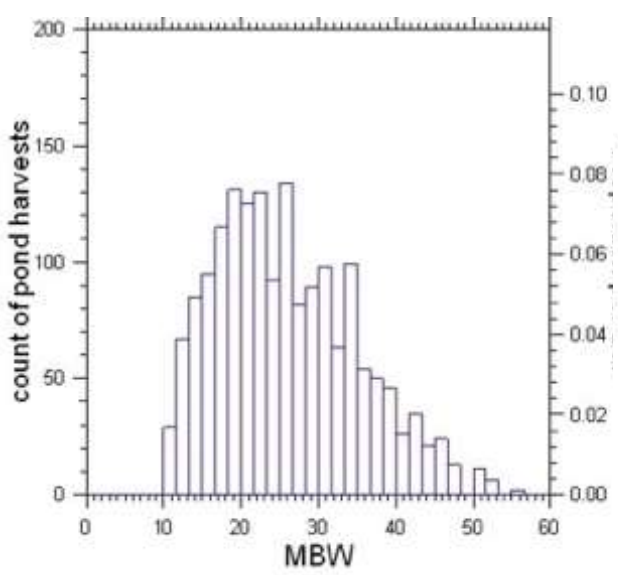
2006



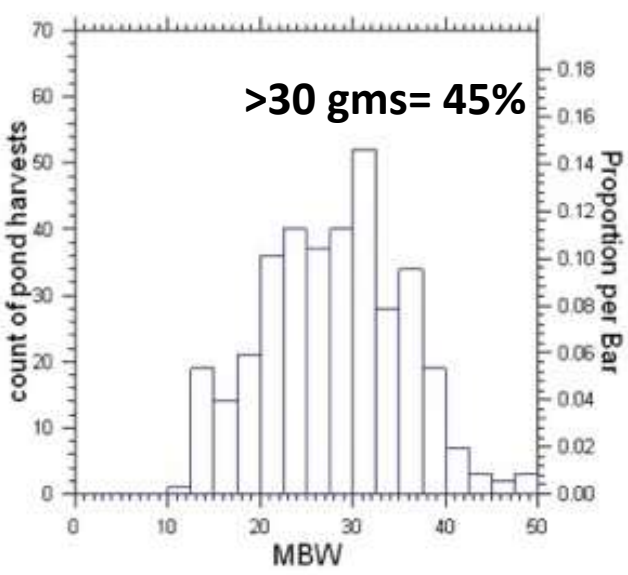
2012



2015



2021

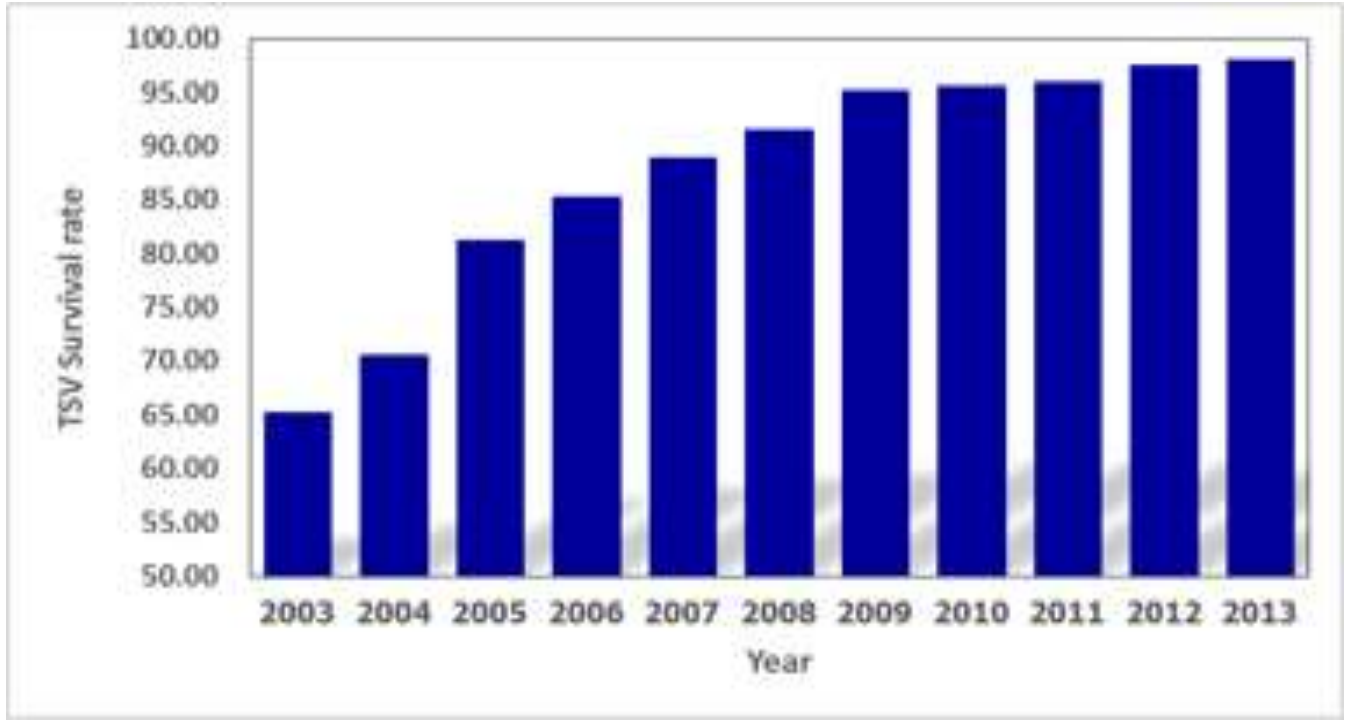


30 gms = 0 percent

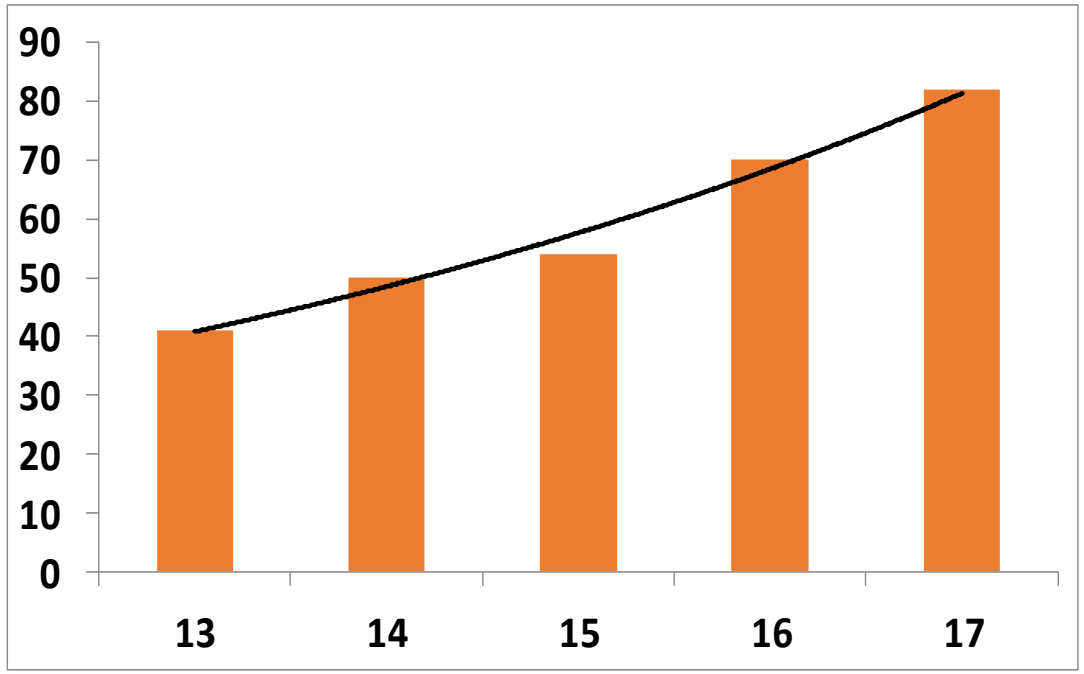
>30 gms = 45 percent

Disease Tolerance has been developed in Turbo

TSV



AHPND



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

CP Turbo

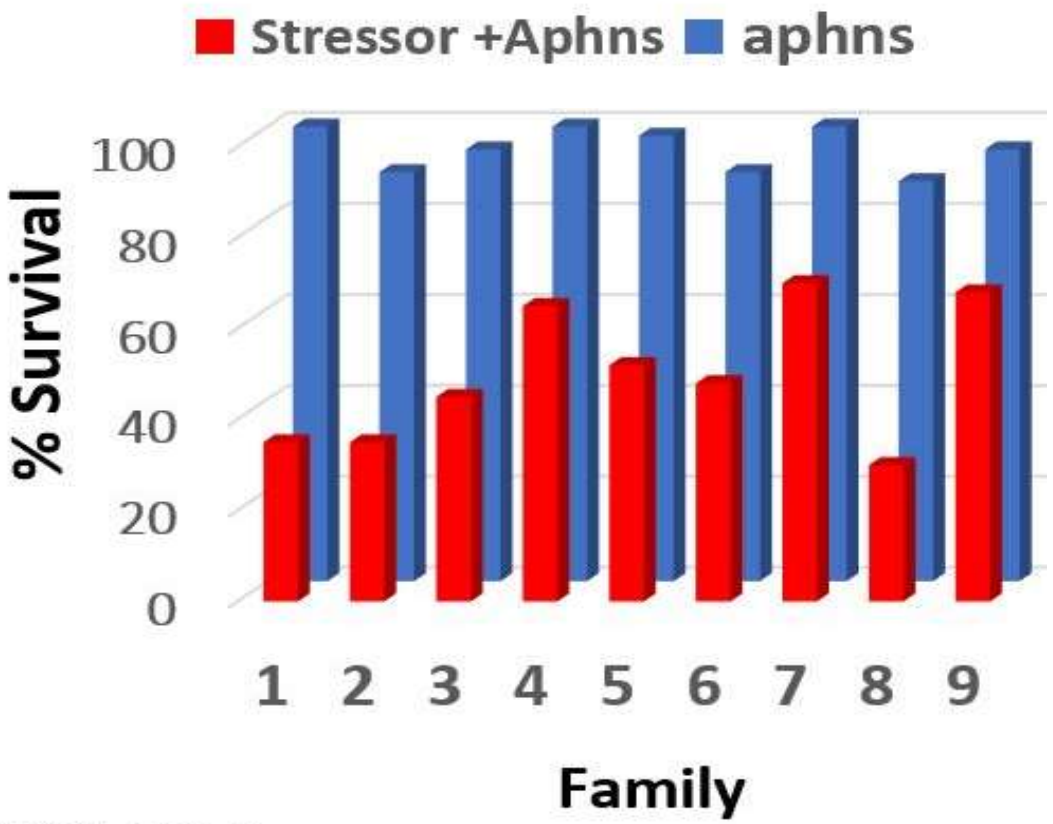
- Improved survival rate from EMS/AHPND
- Capability to grow in environment fluctuated condition to large size
- Require good bio security system

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

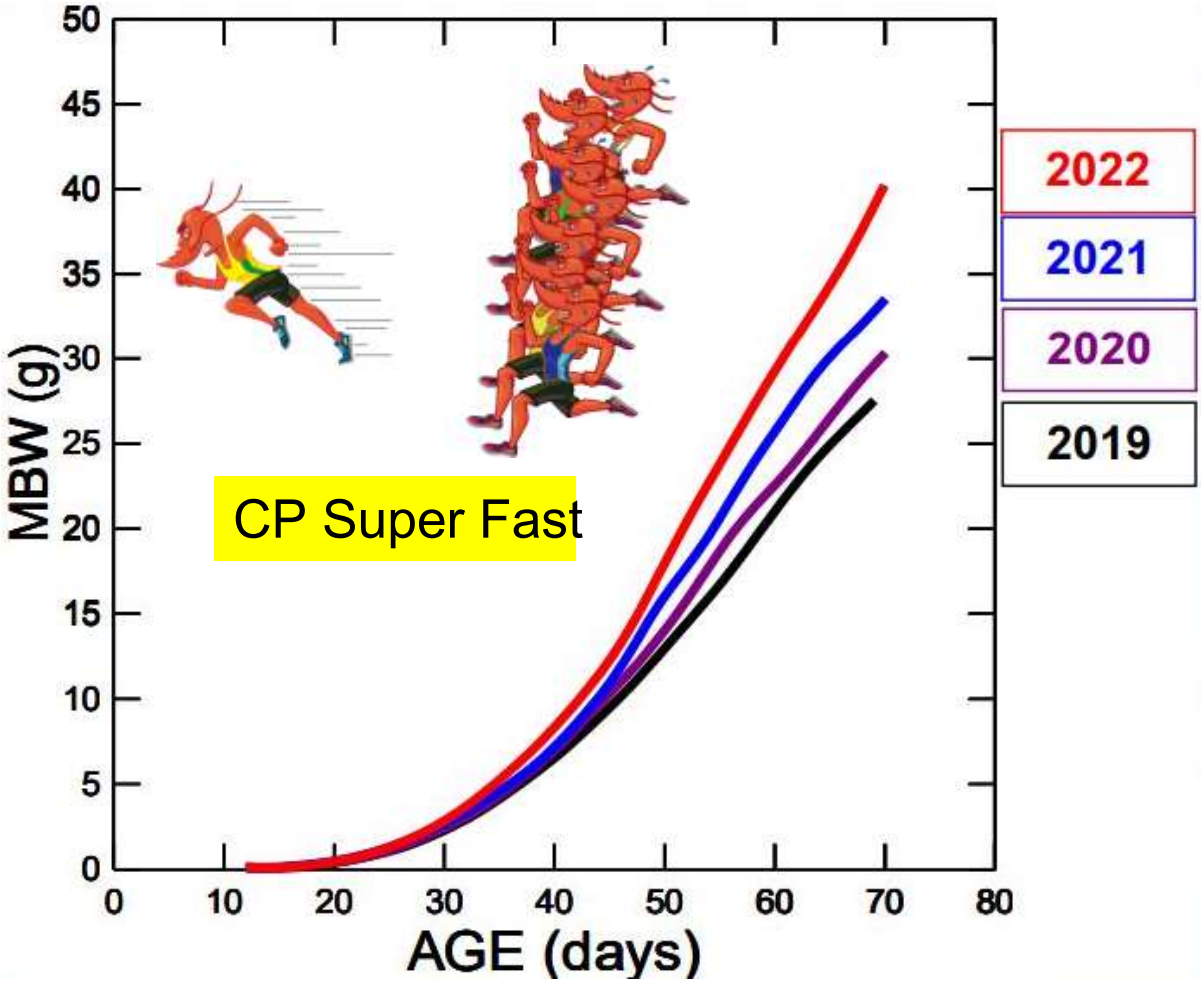
Presence of Pathogens do not mean Disease!!

Ponds for CP Turbo

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

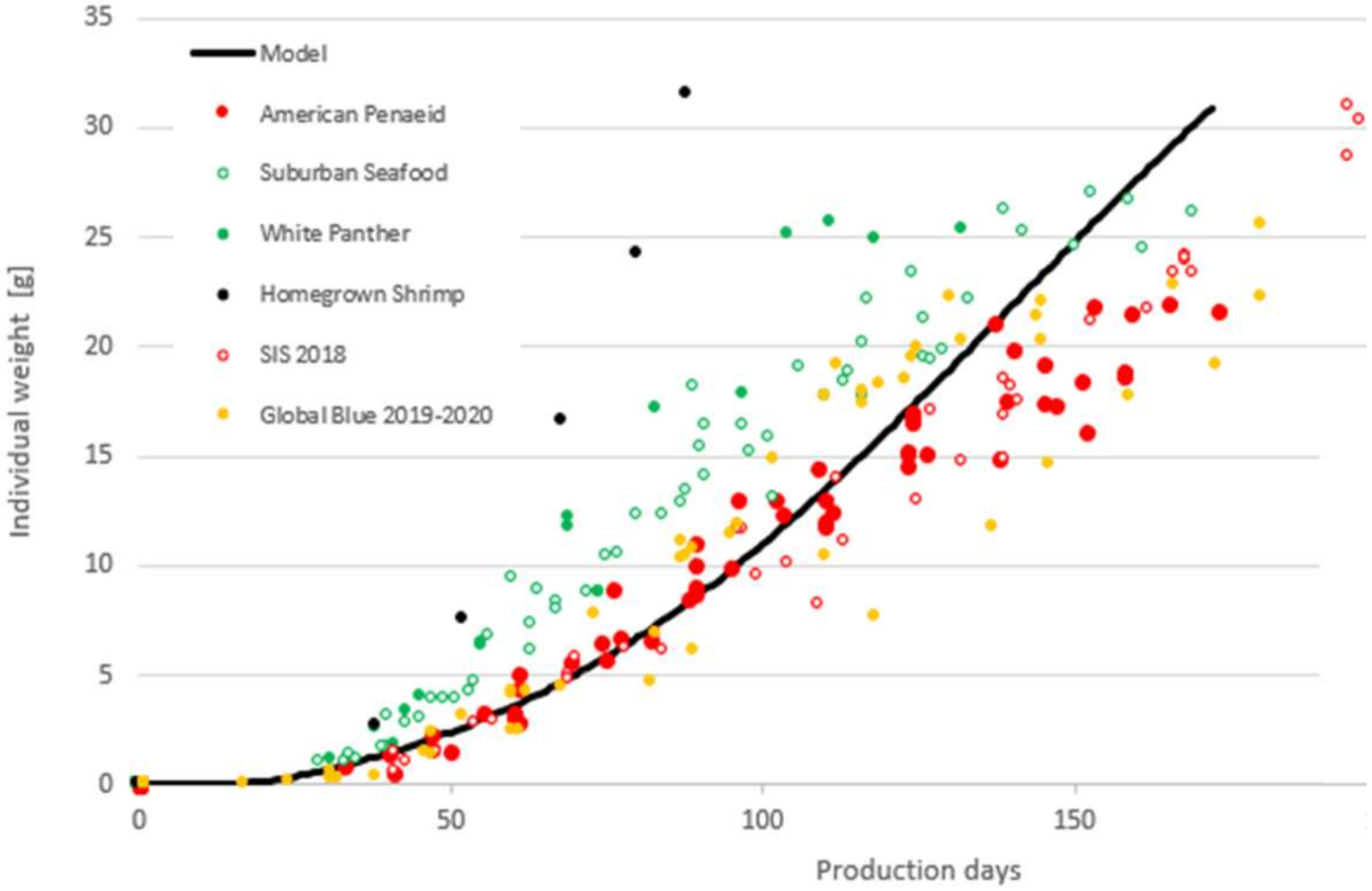
Bio-secure Tank Farms
Clean and Fast Growth Shrimp

Development of Fast Win: Indoor Super Bio-secure systems



Culture system; Bio floc, Temp 30-31 °C, Feed 48% high protein

The CP Win Grown Indoors Super Intensive Europe



CP KONG
WSSV tolerance with Greater Robustness

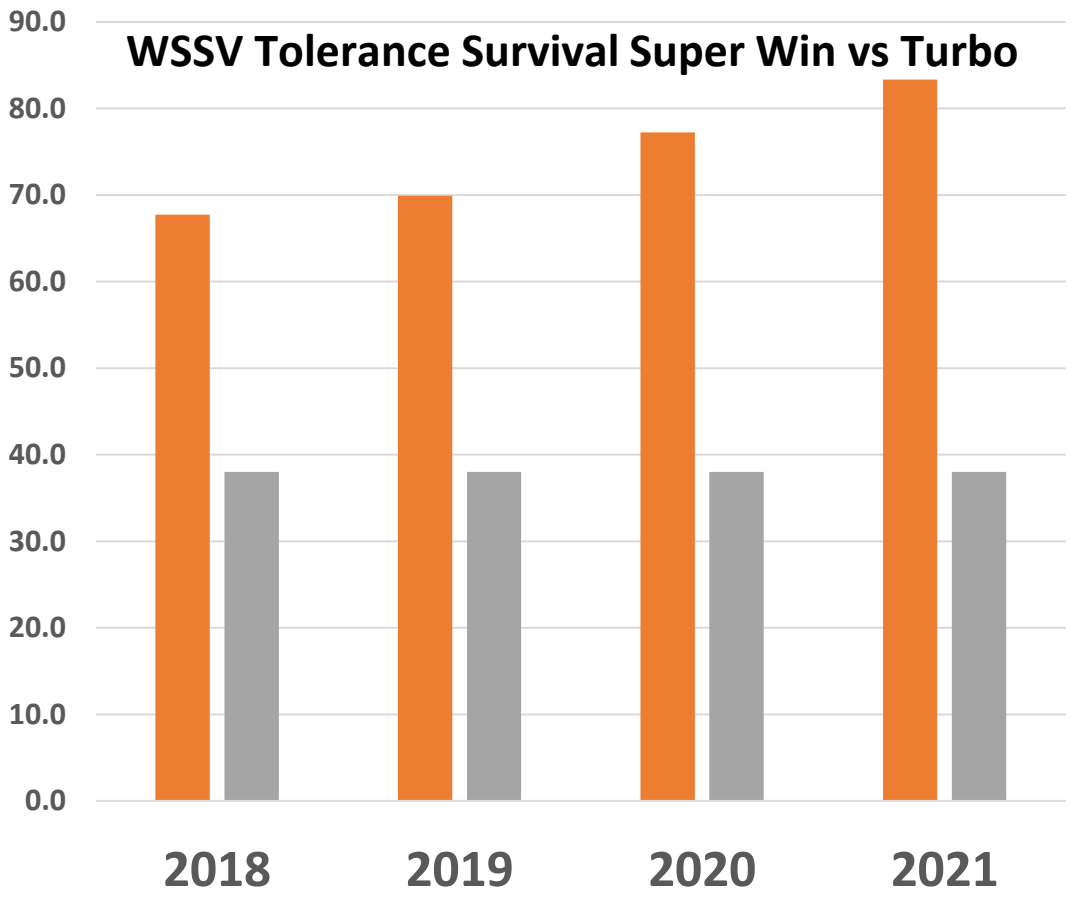
- Growth Rate: 15 gms 0.17 (85)
  30 gms 0.29 (105)

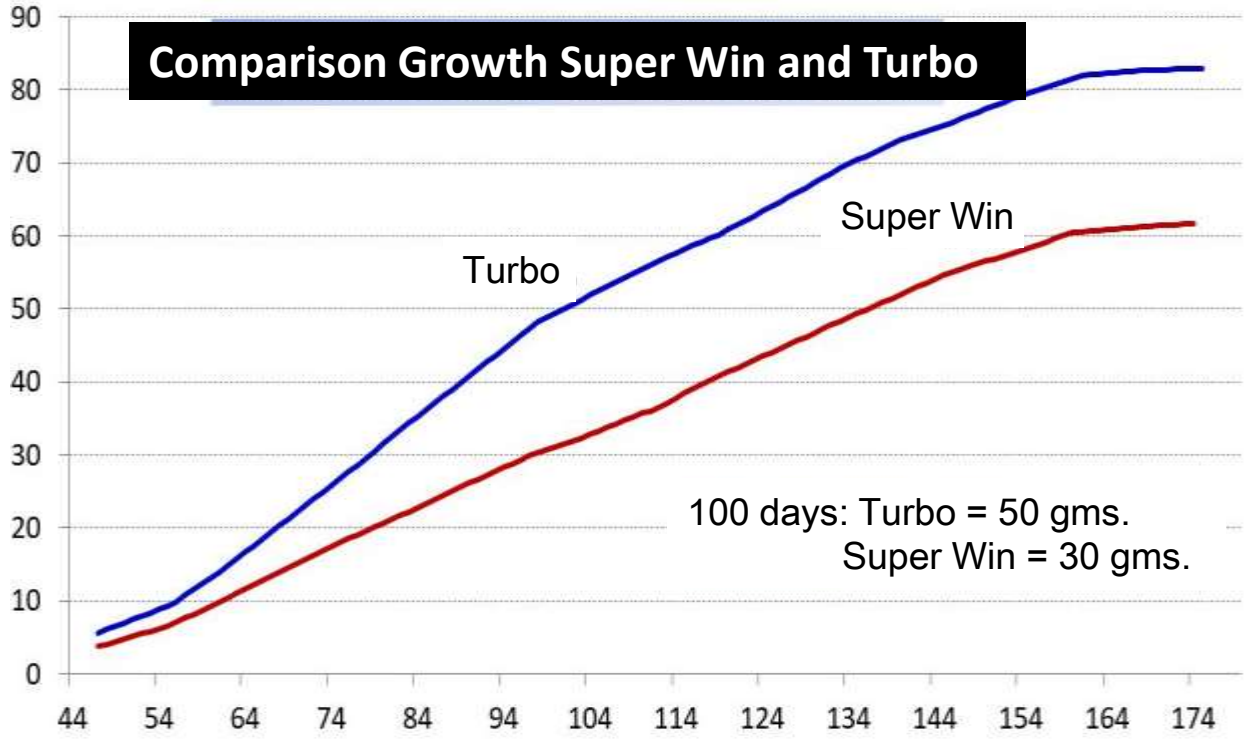
Requirements:

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

Success Stories with CP Super Win

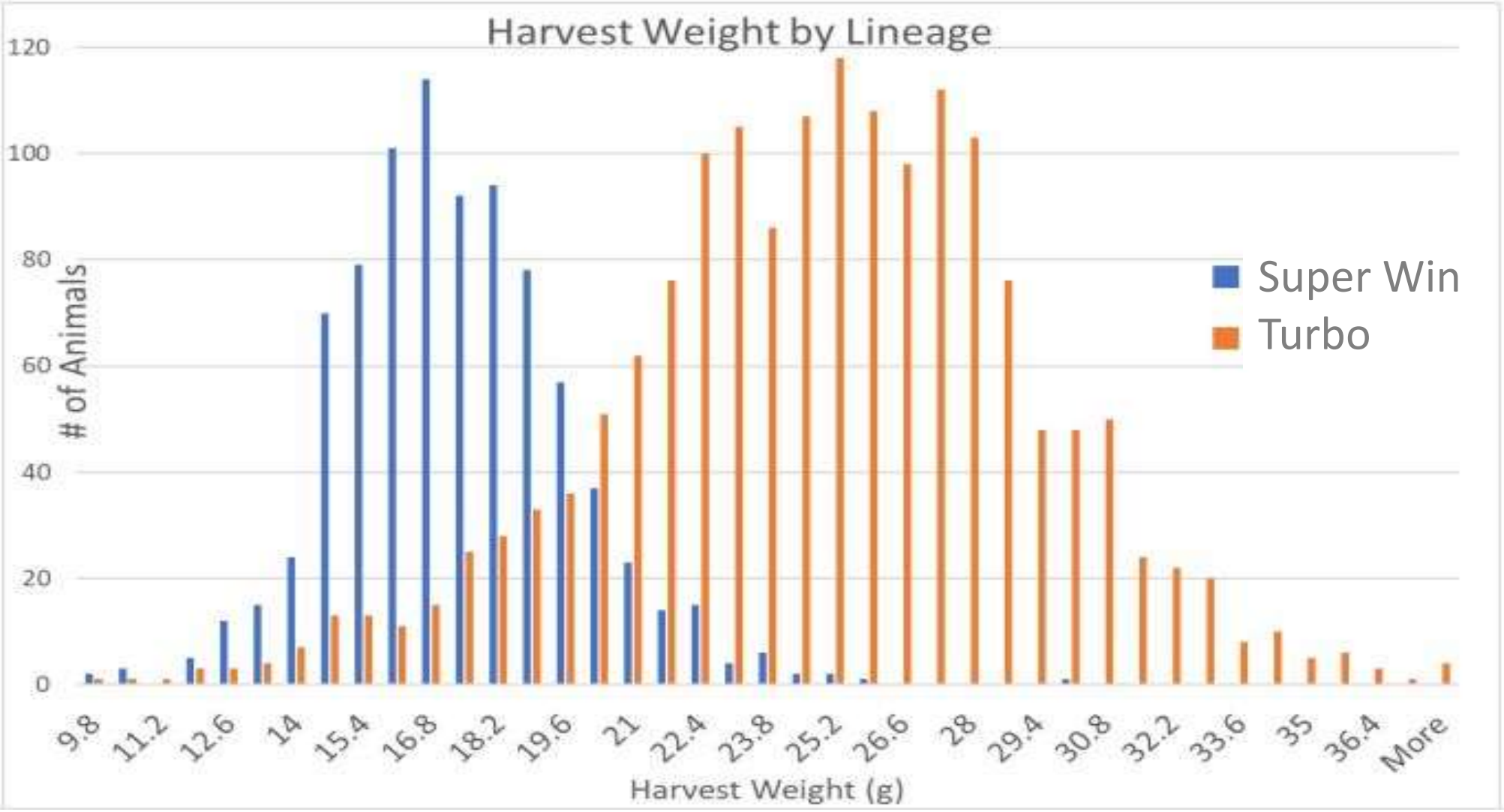
CP Super Win: WSSV tolerance Tradeoff with Growth





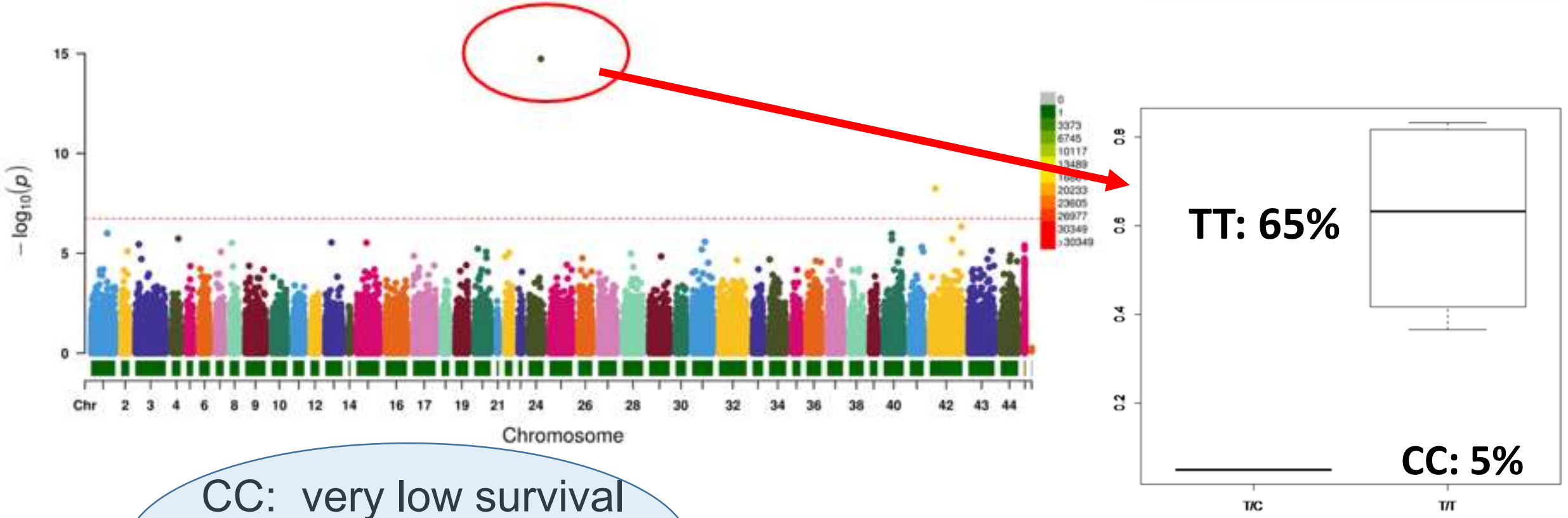
Note; Growth of Super Win can be same as Turbo if pond conditions are not optimized: oxygen, feed, bottoms

Results form stocking SUPER WIN and TURBO families in same pond (good environment/management)



First Identification of WSSV tolerance Molecular Markers

(Importance allows for powerful individual selection)



CC: very low survival
CT: moderate survival
TT: high survival

Survival rate of families with different genotypes
marker

The Industry is Asking for Robust :

Considerations:

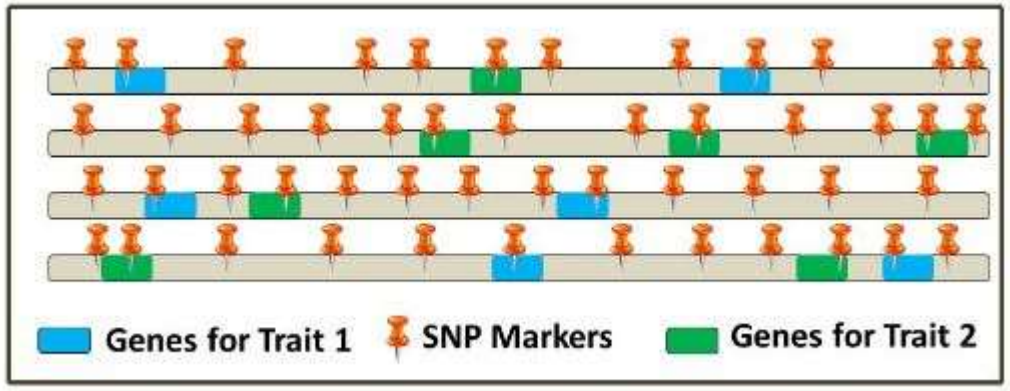
- Inbreeding
- Genetic Diversity
- Heterozygosity
- Innate Immune system

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

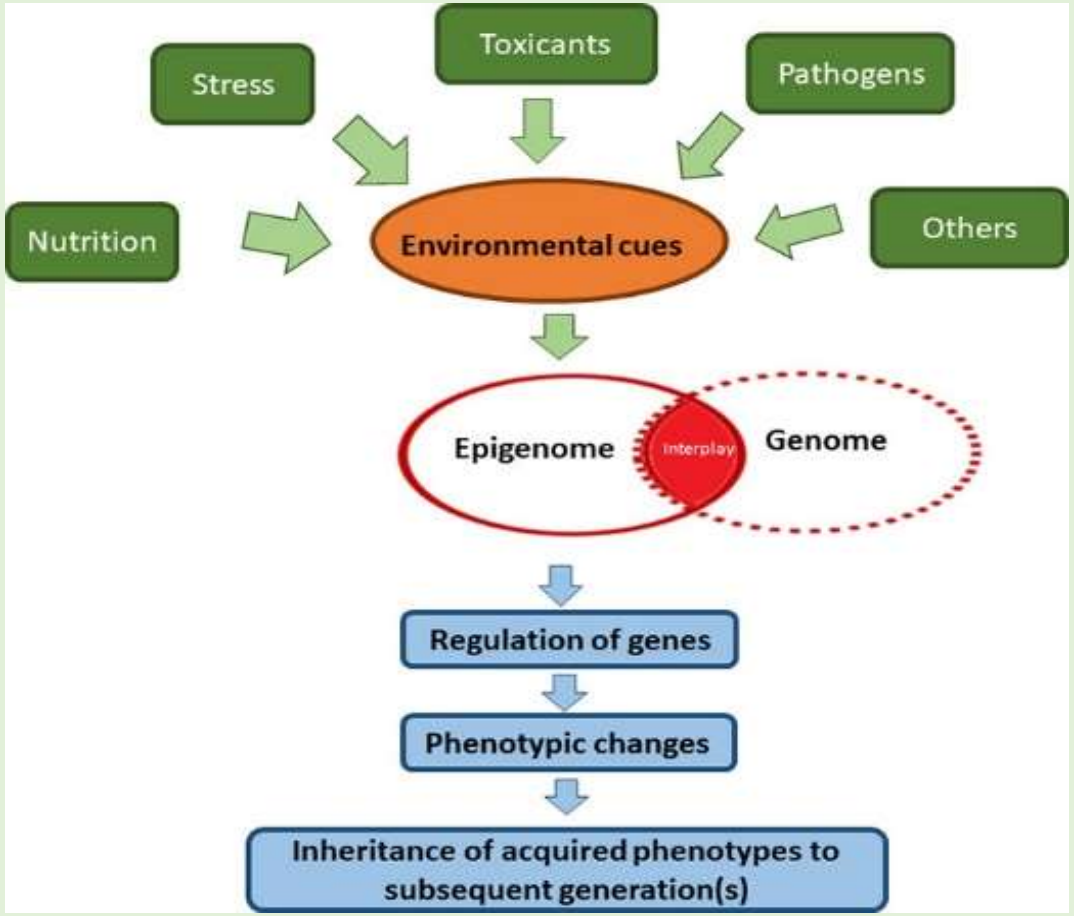
Improvements in Robustness: Mendellian Selection vs Epigenetic Manipulation)

Increase robustness through selective Genetics/ family and individuals

Classic challenge provides Inputs to develop multi trait SNP chips

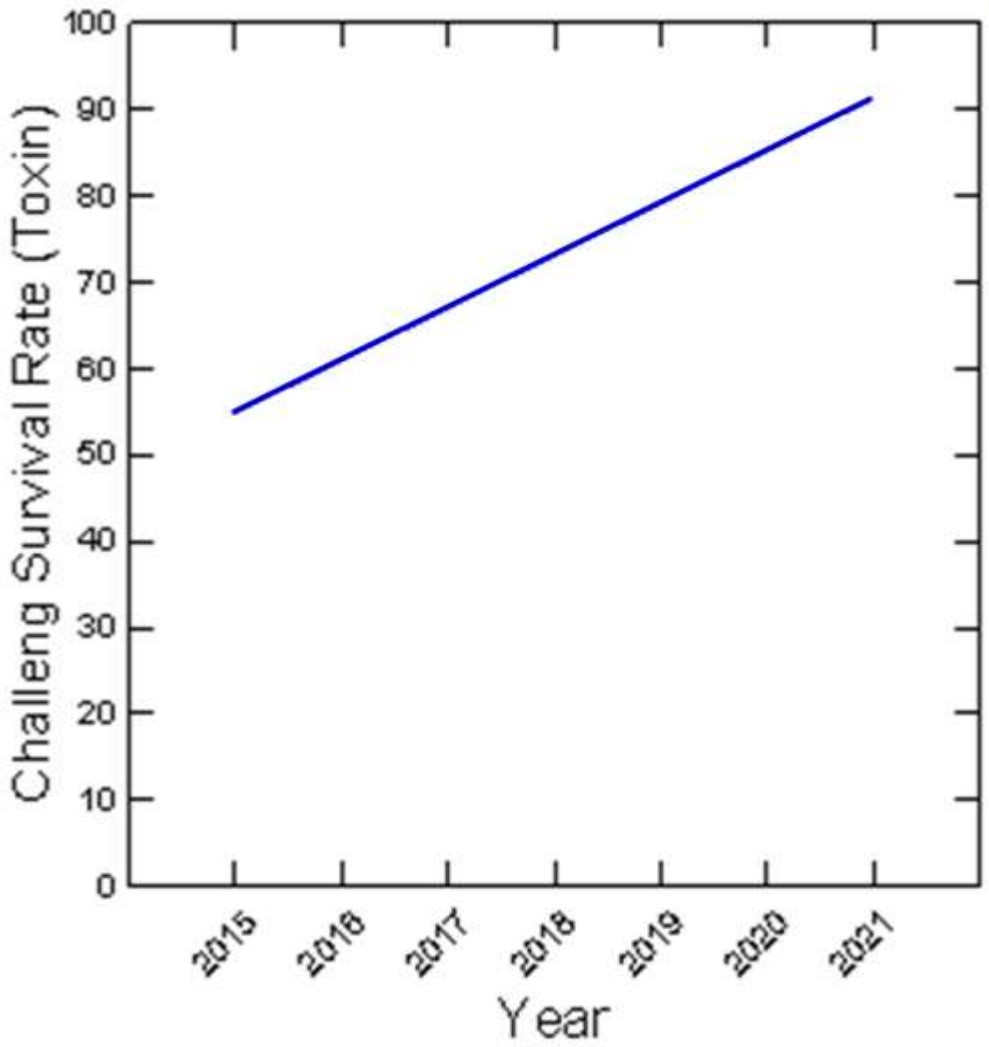


Increase tolerance through manipulation of the genome (epigenetics)



Epigenetic manipulation
can increase survival (robustness) of shrimp under stress

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



Development of The Gator will be CPF's Most Robust Strain

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

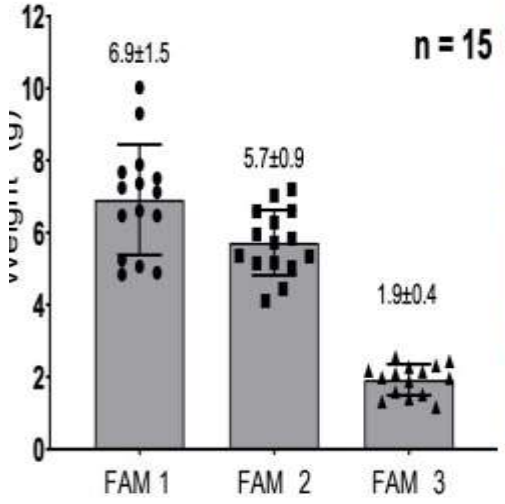
EHP and Vibriosis have become a serious Issue on Farms due to Stress

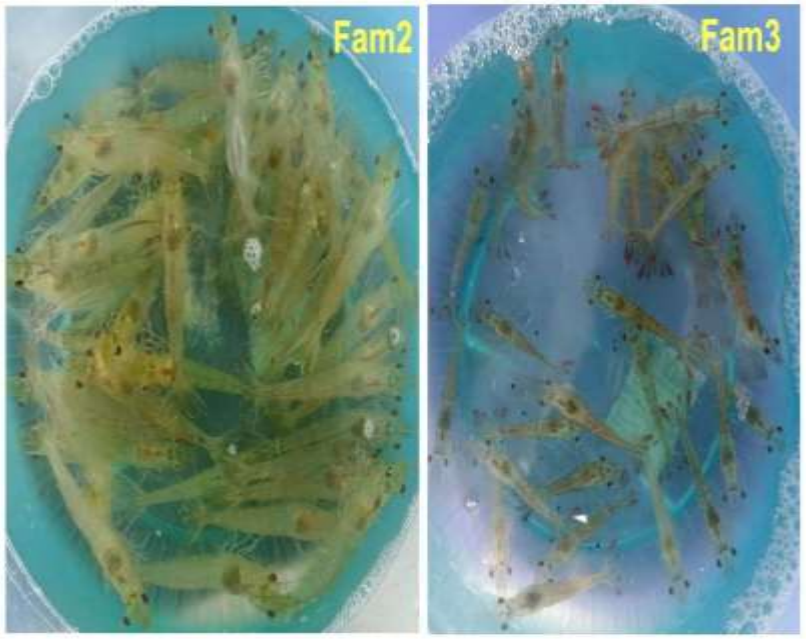
Increase the Resting levels of Immune peptides

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

EHP Tolerance Marker 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

CPF also Provides the leading **SPF Black Tiger**

Stocking Density : 80,000 pcs/rai

%Survival rate : 75 %

ADG : 0.28

FCR : 1.5

Marketing size : 30 pcs/kg

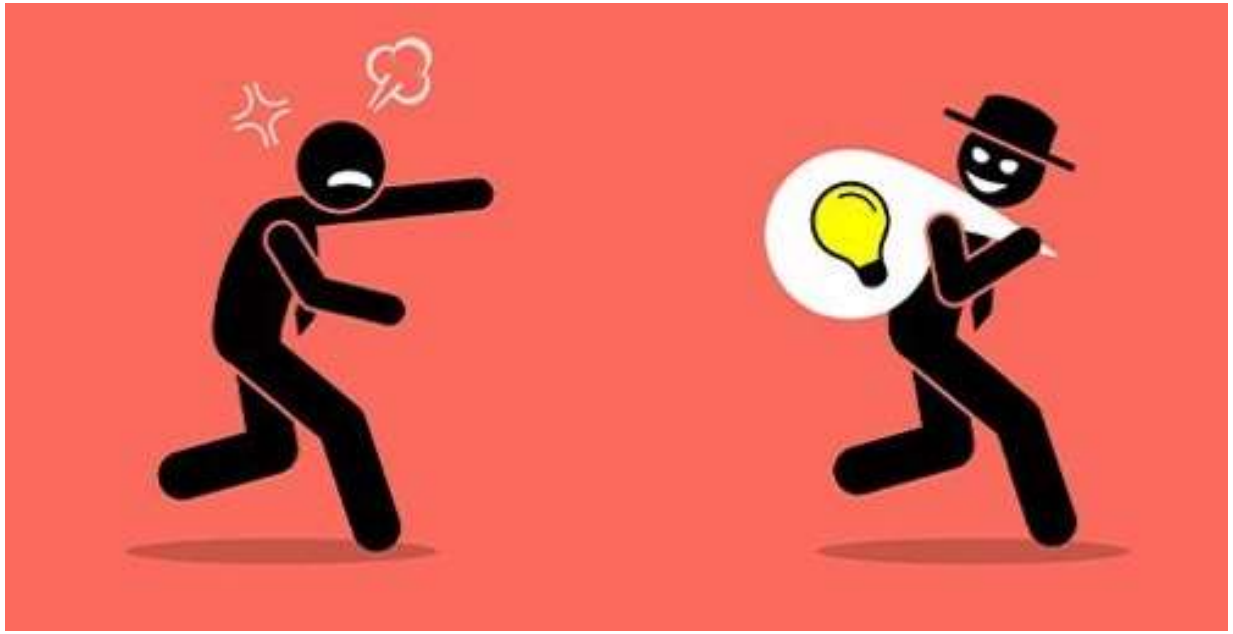
Yield : 2,000 kg/rai

DOC : 115 days

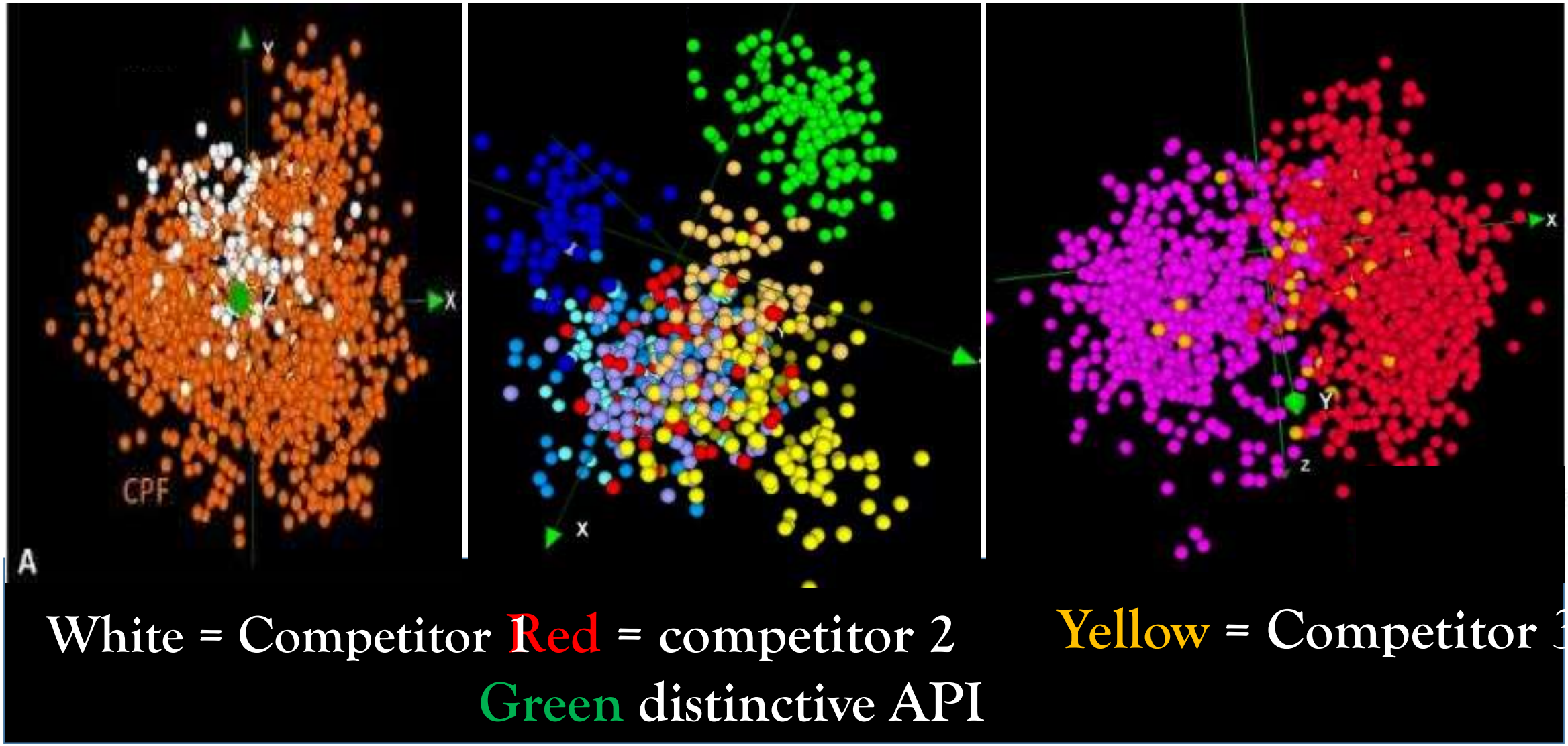
Cost : 100 Baht/kg

Largest Issue for Shrimp Breeding going Forward:

- Protection of Intellectual property of genetic materials
- Running a “proper genetic program” requires large investment:
- A question we are asking : why would we continue to invest if 5-10 years of investment can be lost overnight



Competitor Breeds seem to be inside the CP Gene Pool



White = Competitor Red = competitor 2 Yellow = Competitor 3

Green distinctive API

CPF Leads the World in Broodstock Development

How Do we Know???

Because so many broodstock companies

"Borrow" from our genetics

And there is not one company we have a need to "Borrow"

CP LISTENS

to

the Needs of both the Shrimp Industry and Farmer

and

CP RESPONDS