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Health & Welfare

Breeding shrimp for fast growth and virus resistance

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By Jim Wyban, Ph.D.

Future of shrimp farming will be based on disease-resistant, fast-growing and pathogen-free shrimp stocks

When U.S. shrimp farmers had disease problems in the late 1980s, scientists at the Oceanic Institute in Hawaii developed a stock of shrimp that was specific pathogen free (SPF) to assist them. U.S. industry-wide use of SPF postlarvae (PLs) led to a doubling of the industry's production in 1992 and through 1994 (Fig. 1).

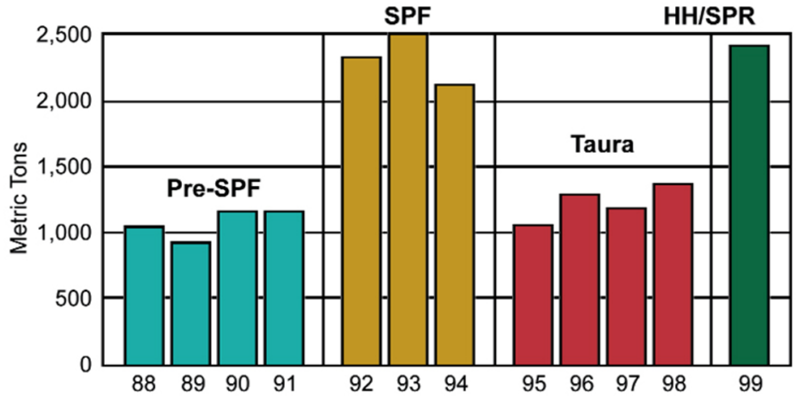

Fig. 1: U.S. shrimp farming production by year. Different color bars indicate distinct eras of production.

SPF in Ecuador

In a large commercial trial of SPF shrimp in Ecuador in 1993, more than 250 million SPF PLs produced from Hawaii-raised SPF broodstock were stocked in commercial ponds throughout Ecuador. The results were disastrous. The SPF shrimp were highly sensitive to Taura Syndrome Virus (TSV). SPF alone was not the answer.

Breeding for taura resistance

By 1995, TSV reached Texas in the United States, and the industry's production dropped to half of the 1994 production (Fig. 1). Again, SPF stocks were highly susceptible to TSV.

High Health Aquaculture, Inc., a company formed in 1993 to commercialize Oceanic Institutes's SPF research, set out to develop stocks that were both SPF and specific pathogen resistant (SPR) for TSV. In 1999, High Health's first SPR stocks were used in Texas, and the state's production reached its highest level since before TSV (Fig. 1).

In the spring of 2000, High Health completed its fourth round of selection for TSV resistance in *Litopenaeus vannamei*. One select *L. vannamei* group (G4 in Fig. 2) averaged 92 percent survival compared to 31 percent survival for the non-select group. One of the select groups achieved 100 percent survival in the TSV challenge.

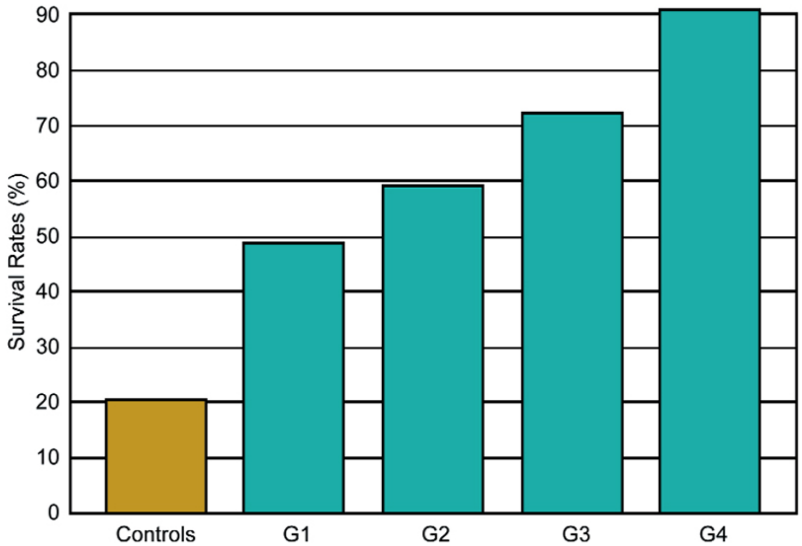

Fig. 2: Mean TSV-challenge survivals by generation for selected groups (green bars) and non-selected controls (gold bar).

Over four generations of selection, the mean survival of select groups increased an average of 15 percent per generation (Fig. 2). These data demonstrate that breeding shrimp for virus resistance is feasible and that rapid progress is possible with a carefully designed program.

Breeding for fast growth

Dramatic improvements in shrimp growth rates also have been achieved. Outstanding growth rates to harvest sizes of 22 to 25 grams were commonplace in Texas in 1999 and 2000. Rapid growth of High Health animals in eastern Mexico in 2000 resulted in two crops produced there for the first time.

Breeding for WSSV resistance

Encouraged by success in breeding for TSV-resistance, High Health initiated efforts in 2000 to breed for resistance to White Spot Syndrome Virus. Inbred and out-crossed families of SPF/SPR *L. vannamei* were separately challenged with both TSV and WSSV. In the WSSV challenge, genetic variation was surprisingly similar to earlier efforts with TSV. TSV and WSSV challenge survivals were not correlated, but several groups had significant survivals in both challenges.

Zero-exchange, bio-secure systems

Recent successes using zero-exchange, bio-secure grow-out systems have reemphasized the importance of stocking disease-free PLs (McIntosh 2000). The only certain method for producing these is by using high-health broodstock in a biosecure hatchery. As use of bio-secure systems expands, so will the demand for disease-free shrimp.

Conclusion

Recent successes have proven that breeding shrimp for fast growth and virus resistance is both feasible and highly effective. The future of shrimp farming will be based on domesticated shrimp stocks that are disease-resistant, fast-growing and pathogen-free. This trend will make shrimp farming more environmentally responsible by limiting its reliance and impact on wild stocks, and eliminating global transport of pathogen-contaminated PLs and broodstock.

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Author

JIM WYBAN, PH.D.

High Health Aquaculture, Inc.
Hawaii, USA
www.hihealthshrimp.com

wyban@gte.net (mailto:wyban@gte.net)