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Dynamics of intensive production of shrimp *Litopenaeus vannamei* affected by white spot disease

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ABSTRACT

A dynamic stock model was used to predict biomass of shrimp *Litopenaeus vannamei* when affected by white spot disease. A database prepared from records of intensive commercial farms in Mexico was used for estimating model parameters for summer and winter production cycles. Parameters were analyzed in relation to stocking density, pond size, and mean values of water quality variables measured during the cycles. Significant results from correlation analysis indicated that final weight of shrimp was positively correlated with mean pond water temperature and dissolved oxygen, but inversely correlated with salinity. When temperature and oxygen increased or salinity decreased, mortality from the disease diminished. Early mortality occurred when water temperature increased, oxygen decreased, or large ponds were used. Stocking density did not affect production parameters. Simple linear regression showed that differences in management of aeration affected oxygen levels. Oxygen concentration and aeration were important factors determining the magnitude of mortality from disease and the time when it occurred. Diminished mortality occurred later in the culture period with higher aeration or early start of aeration. Multiple regression analysis was used to predict model parameters as a function of water quality and management variables. Simple regression analysis and an equivalence test indicated that biomass at harvest was adequately predicted by the stock model and multiple regression coefficients. Predicting shrimp production indicated that raising aeration from 9000 to 14000 horsepower per hour per hectare (Hp h ha^{-1}) increased biomass at harvest from 6610 to 8750 kg ha^{-1} (32%). On the other hand, starting aeration at the beginning of the culture cycle resulted in 8360 kg ha^{-1}, while starting after 5 weeks yielded 6840 kg ha^{-1} representing a reduction of 18%. Management of aeration in small ponds is recommended as an approach to reducing mortality from white spot disease.

1. Introduction

Shrimp farming is the most important aquaculture activity in Mexico. According to CONAPESCA (2007), production during 2007 reached 112 000 tons, representing 60% of the total aquaculture production.

The white spot syndrome virus (WSSV) is the most lethal pathogen of cultured shrimp (Rahman et al., 2006). This has led to investigations from different perspectives. Changes in water quality and their dependence on climatic factors have been studied as stressors increasing shrimp susceptibility to the disease in *Litopenaeus vannamei* (Peinado-Guevara and López-Meyer, 2006).

The effect of salinity on the immune response and outbreaks of white spot disease in *Marsupenaeus japonicus* were studied by Yu and Guan (2003). Liu et al. (2006) studied the effect of acute change in salinity on the white spot syndrome in *Fenneropenaeus chinensis*. Vidal et al. (2001) and Rahman et al. (2006) studied the effects of hyperthermia on the incidence of WSSV in juvenile *L. vannamei*. Other researchers investigated the relationship between immune response and low dissolved oxygen (Le Moullac et al., 1998) and alkalosis and ammonia toxicity (Kautsky et al., 2000; Chen and Chen, 2000; Cheng and Chen, 2002; Magallon et al., 2006a,b).

An epidemiological study used logistic regression analysis to analyze the presence or absence of shrimp diseases as a categorical dependent variable (Leung et al., 2000). Corsin et al. (2001) used this type of regression to study risk factors associated with infection of *Penaeus monodon* by WSSV in a Vietnamese rice-shrimp farming system. Yet, the analysis of the impact of white spot disease from a

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