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REARING OF ROHU, *LABEO ROHITA* (HAM.) IN BAMBOO FRAME POLYHOUSE POND IN WINTER SEASON

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Rohu, *Labeo rohita* was reared in polyhouse and open-air experimental ponds at CIFA farm complex, Bhubaneswar during 2nd December, 2007 to 10th March, 2008. The even span bamboo framed structure (12 × 8 m) with central height 2.7 m and lateral height 1.5 m was erected over one pond of 10 × 6 m and over it 250 micron LDPE sheet was spread to give greenhouse effect in pond. The monitored water quality parameters such as dissolved oxygen, pH, transparency, free carbon dioxide, ammonia, nitrite and total alkalinity were found to be similar in both the control and polyhouse ponds, and were in acceptable range for the fish culture. However nitrate and plankton were recorded more in polyhouse pond water than the control during experimentation. The mean growth of rohu was 76.67 g over the initial of 75.83 g and percentage increment was 101.11 in polyhouse pond during the rearing period. In open-air pond the growth was 28.33 g over the initial with percentage increment of 37.15. The study revealed that the plastic covered pond could maintain the water temperature 5.2 - 7.0^{o}C higher over the open-air pond during the winter season.

INTRODUCTION

In inland plains of India the ambient air temperature falls to 10 ^{o}C or even below in winter season. Air temperature influences the water temperature, which is the most important factor for fish growth (Brett and Groves, 1979; Corey *et al.*, 1983). Growth rate increases with increasing water temperature, but when the temperature becomes super optimal, it has a negative effect instead of a stimulatory influence (Jobling, 1993). Due to lower water temperature in the pond, the metabolic activity of fish reduces (Halver, 1972), growth retards, mortality increases, and thereby affects the fish production per unit area. Sometimes extreme months of winter season witness virtually no growth due to stoppage of food intake by fishes below 15 ^{o}C water temperature. It is necessary to maintain the water temperature between 18.3 and 37.8^{o}C (Jhingran, 1975) for better fish production. Especially in carp farming, the gross production may be hampered below 18.3 ^{o}C water temperature. In sub-tropical climate, extension of growth period is obligatory to enhance the fish production. Several workers have reported using polyhouses to increase the water temperature in cultured ponds for higher fish production (Kumar *et al.*, 2000;

Mohapatra *et al*., 2002 & 2007; Khan *et al*., 2004; Sarkar and Tiwari, 2006; Jain, 2007). Khan *et al*. (2005) have studied the impact of polyhouse culture on ovarian maturity, growth, muscle and egg composition in two Indian major carps: rohu, *Labeo rohita* and catla, *Catla catla;* and two Chinese carps: grass carp, *Ctenopharyngodon idella* and silver carp, *Hypophthalmichthys molitrix* during winter. Results of the study revealed that polyhouse-cutured fishes, in general, exhibited better (P<0.05) values for weight increment, gonado-somatic index, total number of eggs/fish, number of eggs/g body weight and egg diameter. In passive system, fish pond is covered with the transparent plastic film without any auxiliary heating source. The water body gets heated by natural convection process and absorption of direct solar radiation. The present study was carried out with the objective to assess the effects of polyhouse on fish growth during winter months. Indian major carp, rohu, *L. rohita* (Hamilton), which is widely cultured throughout India and some parts of Asia owing to its high market value and consumer acceptability, was selected as the experimental species.

MATERIAL AND METHODS

The culture experiment in low-cost bamboo framed polyhouse pond along with control was conducted during 2nd December, 2007 to 10th March, 2008 at CIFA farm complex, Bhubaneswar (Latitude 20^{o} 15′; Longitude 85^{o} 52′ and altitude 33 m above MSL). The experimental place is grouped under warm and humid climate (Bansal and Minke, 1988), but the temperature in winter months falls below 18 ^{o}C retarding the IMC growth. The size of each experimental pond was 10 × 6 m. The water volume in the pond was 50 m^{3} with mean water depth maintained at 1 m. The even-span shape bamboo framed structure (12 × 8 m) with central height 2.7 m and lateral height 1.5 m was erected over the pond, and 250 micron LDPE sheet was covered over it for greenhouse effect. Simultaneously, control was maintained in a similar size pond without cover. The ponds were stocked with 50 numbers of rohu, *L. rohita* (avg. wt. 75.83±13.96 g and avg. length 186.1±20.01 mm). Normal culture practices were followed during the experimental period. The fishes were fed with supplementary pelleted floating feed (protein content 30%, Godrej make) at 2-3% of fish biomass twice a day during the culture period. Feeding rates were adjusted periodically for weight gain in fish. The sampling was done at 15 days interval throughout the rearing period to assess the growth of the cultured fishes. Water, ambient air and polyhouse air temperatures were measured on hourly basis once in a week with mercury thermometer having least count of 1 ^{o}C. Water quality parameters *e.g.* dissolved oxygen, pH, transparency, free carbon dioxide, total alkalinity, ammonia, nitrite and nitrate were monitored once in a week following standard laboratory procedures (APHA, 1998). Phytoplankton and zooplankton samples were taken from both the ponds for qualitative and quantitative analysis in every fortnight. Diurnal variation study for pond water qualities was also made in a typical colder day during the experiment.

RESULTS AND DISCUSSION

The water temperature recorded in polyhouse pond was higher than that of open-air pond throughout the experimental period (Table 1). This was due to heating of water by polyhouse effect and simultaneous reduction of thermal loss during night hours. Similar increase of temperature in polyhouse pond was also reported in two earlier experiments conducted at CIFA, Bhubaneswar (Mohapatra *et al.* 2002 & 2007). Hourly variation of water temperature in polyhouse and open-air pond; polyhouse room and ambient air on a typical colder day (13.01.2008) is represented in Fig. 1. The maximum water temperature was recorded at 15:00 h of the day and minimum temperature was in the morning hour at 5:00 h. According to Zhu *et al.* (1998), the greenhouse ponds are good alternatives to maintain the water temperature. Klemetson and Rogers (1985) could achieve 2.8-4.4 °C increase in water temperature for each month of the year in greenhouse or plastic shelter pond when compared with an open-air pond. However, the benefits of temperature rise in polyhouse pond in winter period are yet to be utilized for aquaculture purposes in India.

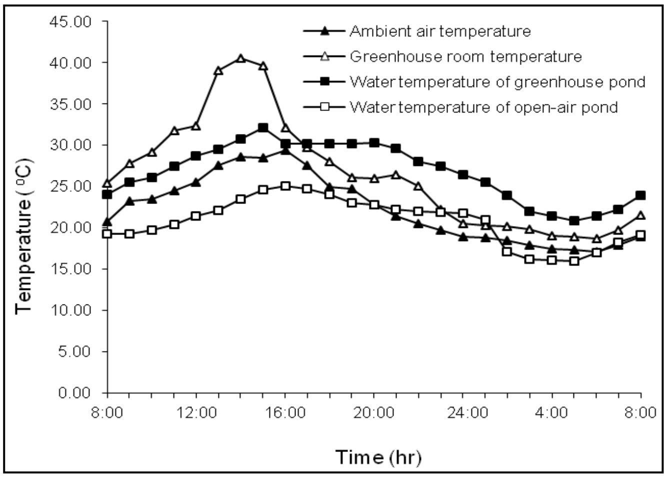

Fig. 1. Hourly variation of temperature with time on typical winter day (13/01/2008)

Water quality parameters such as dissolved oxygen, pH, transparency, free carbon dioxide, total alkalinity, ammonia and nitrite (Table 2) were well within the optimal ranges reported for the species and did not differ between control and experimental ponds. Nitrate was higher in polyhouse pond water. However, dissolved oxygen concentration was recorded lower in polyhouse pond than the open-air pond in the morning hours. In polyhouse pond, greater respiration by pond biota (fish, plankton and benthic organisms) in higher temperature than the open pond added to the decrease in oxygen concentration during night time. But in afternoon hours dissolved oxygen concentrations were of similar magnitude in both types of ponds. Plankton mass was recorded significantly higher in polyhouse pond water. Zooplankton community was dominated mainly by Naupli, Cyclops, *Daphnia* sp., *Moina* sp., *Brachionus* sp. and *Keratella* sp. Phytoplankton was dominated by *Cosmarium* sp., *Senedesmus* sp. *Cyclotella* sp., *Anabaena* sp., *Pandorina* sp., *Oscillatoria* sp., *Merismopedia* sp., *Nitzschia* sp., *Navicula* sp., *Melosira* sp., *Gyrosigma* sp., *Fragillaria* sp. and *Synedra* sp. Higher concentration of nitrate (Lovejoy *et al.*, 2004) and temperature (Mathew, 1975) contribute to the higher production of plankton in water medium. In the present experiment, higher nitrate concentration and temperature had contributed to the higher production of plankton in the polyhouse pond water. These plankton species were suitable as live feed for fish and their abundance had contributed to the significant higher fish growth in polyhouse pond than control.

Table 1. Water temperature (°C) (Mean±SD) in polyhouse and open-air pond during winter months at CIFA, Bhubaneswar

Months	Open-air pond		Polyhouse pond	
	Min.	Max.	Min.	Max.
December, 2007	17.1±0.71	26.0±1.09	25.1±1.13	31.4±1.46
January, 2008	16.2±1.17	25.1±1.03	21.4±1.04	32.2±1.01
February, 2008	19.1±0.47	28.0±1.07	22.1±0.97	32.3±1.09
March, 2008	21.2±0.83	28.3±1.17	25.1±1.01	32.1±1.56

Table 2. Water quality parameters in polyhouse and open-air pond during winter months of 2007-2008 at CIFA, Bhubaneswar

Parameters	Open air-pond	Polyhouse pond
Dissolved oxygen (mg/l)	6.4±2.7	5.2±1.9
Free CO_2 (mg/l)	6.1±1.85	7.0±2.1
Transparency (cm)	21.0± 3.2	17.5±2.8
pH	7.3±1.2	7.4±1.3
Total alkalinity (mg/l as $CaCO_3$)	112.0±22.3	105.0±19.7
NH_4-N (mg/l)	0.037±0.09	0.041±0.17
NO_2-N (mg/l)	0.021±0.012	0.026±0.018
NO_3-N (mg/l)	0.029±0.017	0.059±0.02
Phytoplankton density (×10^3)	9.4±3.1	19.1±5.3
Zooplankton density (×10^3)	4.0±1.2	6.4±2.7

The fish rearing trial of 99 days indicated the promising result in terms of growth in polyhouse pond than open-air pond. The mean size of rohu was 152.52 g (76.67 g higher over initial) and percentage increment in growth was 101.11 in polyhouse pond. Whereas, in open-air pond the mean harvest size was 104.2 g (28.33 g higher over initial) with percentage increment of 37.15. The percentage survival was 96 and 84 in polyhouse and open-air ponds, respectively. The observations showed that in open-air pond the fish growth was not remarkable which might be due to lower water temperature of the culture water. There are few reports for fish culture in polyhouse environment in India. Khan *et al.* (2004) conducted a 122-day trial to observe the impact of polyhouse in winter on growth, conversion efficiencies and body composition of *L. rohita* fingerling. At the end of the trial they could observe that the polyhouse reared fish produced significantly higher values of these parameters. Kumar *et al.* (2000) reported the common carp fingerlings rearing in a polyhouse pond in the Himalayan region. They stocked the pond @ 10,000/ha and found 81% higher growth in fish inside the polyhouse than 11% in open condition within a rearing period of five months. In a field experiment for 20 days at CIFA, Bhubaneswar, Mohapatra *et al*. (2002) reported 45% higher growth rate of common carp spawn in the polyhouse pond. This higher growth rate in fish was attributed to the higher temperature in the polyhouse pond. The present study showed that the plastic covered pond or polyhouse can keep the water temperature 5.2-7.0 ^{o}C higher than the open-air pond in winter season at the present experimental location.

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