Forced-Air Incubation of Catfish Eggs

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ABSTRACT. A low pressure, high volume, forced-air method of incubation was evaluated for eggs of channel catfish, *Ictalurus punctatus*, and channel catfish ♀ × blue catfish, *I. furcatus*, ♂ hybrids and was compared to the traditional paddle-type incubation method. No significant difference was observed in hatching percentage, survival, or weight of sac-fry and swim-up fry or in total weight after 21 days of feeding for 10 egg masses that were divided equally and incubated with paddles or forced air. The forced-air method was inexpensive, safe, quiet, and as effective as paddle-type aeration.

INTRODUCTION

The incubation and hatching of catfish eggs has traditionally involved the use of rotating paddles (Clapp 1929) that simulate the

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post-spawning behavior of the sire by agitating the water surrounding the egg mass to aerate and gently agitate the eggs (Piper et al. 1982; Stickney 1986). While functional and efficient, this traditional methodology has the associated safety hazards of motors, drive systems, rotating paddles, and electricity near the incubation or hatchery troughs. Additionally, the paddle-type systems can be noisy. Forced-air incubation has historically been used to hatch eggs of other species so it was decided to test this method on catfish eggs.

The objective of this study was to evaluate the use of forced-air incubation on channel catfish, *Ictalurus punctatus*, and channel catfish ♀ × blue catfish, *I. furcatus*, ♂ hybrid eggs.

MATERIALS AND METHODS

A 2.5-hp regenerative blower (Sweetwater Inc.[1]), located outside of the hatchery area, provided forced air to the incubation troughs. Air was transferred from the blower through 10-cm (OD) pipe and was provided to individual troughs via 2.5-cm (OD) pipe and 1.3-cm nipple outlets. Flow regulators were attached to flexible, clear plastic tubing (1.3 cm diameter), and ceramic diffusers (15 × 2.5 × 2.5 cm) were placed beside individual egg baskets (51 × 25 × 10 cm) in about 22 cm of water. Paddles (23 × 5 cm) were powered by 33 rpm, 1/16-hp gearmotors.

Ten 80-L hatching troughs, containing one egg basket, were equipped with air diffusers, and another ten were equipped with traditional paddle-type aerators. Water was supplied from a 335-m well. To increase dissolved oxygen concentration and to eliminate supersaturation of gases that could be harmful to fish, the well water was dropped through a 9-m aeration tower prior to use. All troughs had identical water inflow (2 L/minute), turnover rates (1.5 times/hour), and water quality (26°C; 5.0 mg/L dissolved oxygen; 15 mg/L total hardness as $CaCO_3$).

Egg masses from nine matings of channel catfish and a single hybrid cross were used to evaluate the two incubation systems. The

1. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Department of Agriculture or the U.S. Fish and Wildlife Service.

stocks of fish used (Table 1) were described previously (Carmichael et al. 1992), except for the Norris strain (Dunham and Smitherman 1984) and Mississippi-2 which were obtained from local commercial catfish farms. Egg masses (range: 632 to 1,458 g) were collected from spawning cans located in broodfish ponds or spawning cages and were transferred to the hatchery in aerated water. The number of eggs (range: 17,159 to 32,968) was estimated from total weight by a sample count of 150-200 eggs (about 5 g). Each egg mass was weighed and split into two equal portions (Table 1). One half of each egg mass was placed in a basket aerated by paddle, and the other half placed in a basket aerated with forced air. All egg masses were treated daily with an iodine disinfectant (Argentyne; Argent Chemical Co.) until development of eye pigmentation. Hatching percentage was determined by dividing the number of sac-fry by the estimated number of eggs. The number of sac-fry and swim-up fry were estimated from total weights by a sample count of 50-75 fish (about 1 g). Total weight of the fish in each group was recorded at the end of 21 days of feeding.

The two-tailed, paired-comparison Student's t-Test (StatView 512+, software for Macintosh, Abacus Concepts Inc. Brainpower Inc.) was used to compare hatching rates and other variables between paddle-type and forced-air incubation; $P < 0.05$ was chosen as the level for statistical significance.

RESULTS AND DISCUSSION

Hatching percentage was not significantly different between catfish eggs incubated with forced-air or paddle-type aeration ($P = 0.353$) (Table 1). Water quality and temperature remained constant throughout the study, and eggs hatched in each aeration system in 5 to 6 days.

Among the ten matched egg masses, no significant difference was found for the number of surviving sac-fry ($P = 0.316$) or swim-up fry ($P = 0.276$) (Table 2). After 21 days of feeding there was no difference in total weight ($P = 0.132$) (Table 2). Because the hatching success was variable (37% to 100%), although within the normal range observed for experimental stocks at this laboratory,

TABLE 1. Hatching percentage of eggs of channel catfish, and a channel catfish ♀ × blue catfish ♂ cross incubated with forced-air or paddle-type systems.* Egg masses from each spawn were divided equally (± 1 g) for comparisons. For each mating, the female is listed first.

Egg mass	Stock	Weight of eggs (g)	Eggs (N)	Hatching percentage	
				Air	Paddle
1	Mississippi–2 X Norris	300	10,526	56.5	94.2
2	Red River X Mississippi–2	314	8,579	73.8	86.1
3	Norris X Norris	350	11,986	47.6	37.0
4	Mississippi–2 X Norris	385	11,063	54.1	46.8
5	Auburn X Auburn	400	13,157	63.4	56.2
6	Mississippi–2 X Norris	476	12,300	36.8	45.0
7	Norris X Norris	490	12,894	100.0	100.0
8	Auburn X Auburn	525	11,877	82.7	87.0
9	Marion X Blue Catfish	555	12,091	57.4	61.1
10	Auburn X Auburn	711	16,484	64.5	67.9
Mean		451	12,096	63.7	68.1
SE		40	642	5.7	7.1

* No significant difference in hatching percentage was found between the two methods of incubation ($P = 0.353$; two-tailed, paired comparison Student's t–test).

TABLE 2. Number and weight of sac-fry, swim-up fry, and total weight after 21 days of feeding resulting from eggs aerated with forced-air or paddle-type systems. There was no difference between the two methods of incubation for any of the variables tested (two-tailed, paired comparison student's t-test). Eggs were from nine matings of channel catfish ♀ × blue catfish ♂ cross. Identification of spawns is the same as in Table 1.

	Sac–fry				Swim–up				21–days feeding	
	Number		Total weight (g)		Number		Total weight (g)		Total weight (g)	
Egg mass	Air	Paddle	Air	Paddle	Air	Paddle	Air	Paddle	Air	Paddle
1	5,950	9,914	83.8	138.8	5,260	9,122	95.2	165.1	537.7	506.5
2	6,336	7,388	135.6	158.1	6,355	7,407	221.8	258.5	1,385.3	777.5
3	5,705	4,439	75.3	58.6	5,362	4,371	118.5	96.6	190.8	283.9
4	5,987	5,182	95.2	82.4	6,063	5,054	144.9	120.8	643.2	9.2
5	8,352	7,397	149.5	132.4	7,858	6,862	255.4	223.0	276.5	213.9
6	4,528	5,535	64.3	78.6	3,839	5,104	88.3	117.4	135.5	307.4
7	12,904	13,321	201.3	207.8	12,440	13,488	260.0	281.9	1,465.3	1,689.9
8	9,820	10,337	174.8	184.0	10,957	11,372	286.0	296.8	1,781.8	1,022.8
9	6,941	7,386	154.8	164.7	7,066	7,468	223.3	236.0	640.9	274.8
10	10,628	11,194	191.3	201.5	11,718	12,052	290.6	298.8	1,670.7	1,530.5
Mean	7,715	8,209	132.6	140.7	7,691	8,230	198.4	209.5	1,698.4	1,101.5
SE	836	912	15.8	16.7	945	1,004	25.0	24.8	583.7	284.3
P value	0.3162		0.2631		0.2746		0.2907		0.1320	

further trials of forced air incubation on a commercial-level basis are suggested.

The forced-air system was as effective as traditional paddle-type aeration in hatching catfish eggs. Low-pressure, high-volume air pumps and air diffusers are readily available in the aquaculture industry and are easy to install. Forced-air systems presumably offer the additional benefits of lower cost and maintenance and are safer because the electricity and moving parts are located away from the hatchery area. Removal of the paddle systems also resulted in a noticeably quieter hatchery area. Incubation with forced air could provide catfish hatcheries a safer, quieter, and less expensive alternative to paddle-type aeration.

It should be noted that paddle-type aeration and forced-air aeration are not efficient methods for removal of gases from well water. Degassing of gas-supersaturated water prior to use is important in all hatcheries, but may be particularly important in hatcheries using diffused air for egg incubation.

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