Pakistan J. Zool., vol. 39(4), pp. 239-244, 2007.

Introduction of Channel Catfish *Ictalurus punctatus* (Rafinesque) in Pakistan and its Performance During Acclimatization and Pond Culture

ABDUL RAB, MUHAMMAD AFZAL, NASIM AKHTAR, MUHAMMAD RAMZAN ALI, SAFWAN ULLAH KHAN, MUHAMMAD FARHAN KHAN, SULTAN MEHMOOD AND MAZHAR QAYYUM

Aquaculture and Fisheries Program, National Agriculture Research Centre, Post office, National Institute of Health, Park Road, Islamabad-45500, Pakistan (AR, MA, NA, MRA, SUK, MFK, SM) and Department of Zoology, University of Arid Agriculture, Rawalpindi-46000, Pakistan (AR, MQ)

Abstract.- Two thousand fingerlings of channel catfish *Ictalurus punctatus* were imported from Thailand in a bid to introduce this fish in Pakistan. Five percent mortality occurred during transportation. Experiments were designed to observe catfish acclimatization in tanks or raceways for which five hundred fingerlings (average weight 10.86±1.20g) were placed in five tanks of 2000-liter water capacity and another 500 fingerlings (average weight, 10.56±0.68g) were kept in five raceways of 5000-liter water capacity each. The fish were fed on imported diet for a period of 75 days. Mean weight gain of 27.22±1.75 g and 31.5±1.04 g and surv~7.5% and 95.9% were recorded in tanks and raceways, respectively. For studying growth of fish two stocking densities (3,000 and 3,500/ha) were maintained in ponds (0.04 ha) from December 2003 - November 2004. The weight gain was significantly higher in low stocking density (1,263.3 ± 60.9 g) compared with high stocking density (1,184.9±57.1 g). Fish production and survival between two stocking densities was not different (P>0.05).

Key words: Channel catfish; *Ictalurus punctatus;* acclimatization, pond culture, growth performance.

INTRODUCTION

Channel catfish, *Ictalurus punctatus, is* cultured worldwide and has been introduced in more than 32 countries including UK, Brazil, China, India, Thailand and Russia to improve aquaculture production and recreational fisheries (Welcomme, 1988; FAO, 2006). The channel catfish has shown remarkable performance in fresh water pond culture and is the most successful aquaculture business in USA (Engle, 2003). Over 95% production occuring in four states *i.e*. Mississippi, Alabama, Arkansas, and Louisiana (Tucker and Hargreaves, 2003; Rezk *et al.*, 2003). The channel catfish is preferred because of its high quality flesh, lack of intramuscular bones (Hilge, 1981) and ability to withstand lower water quality conditions (Morris, 1993).

In Pakistan, culture system mainly gyrates around carp fishes including both indigenous major carps and exotic Chinese carps (Basavaraja *et al.*, 1999). Although carps have a wide range of acceptability among the consumers, a large segment of populace does not prefer these fish due to large number of intramuscular bones in them. As the climatic condition of Pakistan is comparable to that of the channel catfish growing central states of USA, a preliminary study was designed to assess the adaptability and growth performance of channel catfish in Pakistan. More elaborate and comprehensive studies will be required before a final decision to introduce a new fish in the country is taken.

0030-9923/2007/0004-0239 $ 8.00/0

MATERIALS AND METHODS

Fish

The study was conducted at Aquaculture and Fisheries Programme, National Agriculture Research Centre, Islamabad (33° - 42°N and 73°-08°E), Pakistan. Two thousand fingerlings of channel catfish, *Ictalurus punctatus* air lifted from Cold Water Research Station, Chiang Mai Province in Thailand to Islamabad via Bangkok in 26 hours. Fifty fish were packed in a polyethylene bag filled

with water and oxygen. Two polyethylene bags were placed in each styrofoam box (60x45x30 cm) for transportation.

Acclimatization of fish

Five hundred fingerlings were placed in a five circular fiberglass tanks of 2000-liter water capacity at the rate of 100 fingerlings per tank, and 500 fingerlings in five outdoor concrete raceways of 5000-liter water capacity each @ 100 fingerlings/raceways under flow through systems. Experiment was conducted for a period of 75 days from 21st September to 5th December 2003. These fingerlings were fed to satiation twice daily, seven days a week on commercial floating diet (37% CP) imported from Thailand along with the fingerlings. Fish were sampled from raceway and tanks on day one and then fortnightly with scoop net (mesh size 1.0-cm stretched) to record their length and weight using Sartorious Electronic Balance Model BL150 S.

Fish growth in pond culture

Fish were stocked in 0.04 ha. ponds with stocking density of 3000 fish/ha (120 per pond) and 3500 fish/ ha (140 per pond) from December 2003 to November 2004. Prior to stocking all ponds were filled with tube well water up to a level of 1.2 m and fertilized with organic manure (cow dung) at the rate of 1.5 ton per hectare. The water level was maintained throughout the experiment.

At the time of stocking, weight and length of the fish were recorded and then sampling was done randomly on monthly basis from each pond with drag net (mesh size 3 cm). After recording weight and length fish were released back into their respective ponds. Fish were fed once daily (for ≤ 20 minute) to apparent satiation during the whole study on sinking type diet containing 30% crude protein developed from locally available feed ingredients.

The ingredients of experimental diet, on dry weight basis, used in pond culture were fish meal, 30%; soybean meal, 10%; sunflower meal, 5%; canola seed meal, 5%; rice polishing, 22%; gluten 30%, 19%; wheat bran, 5%; vitamin-C, 0.50%; Vitamin premixes, 1.50% and soybean oil, 2%.

The proximate composition (%) of this diet was dry matter, 89.80% and moisture, 10.20%. The percentage comparison (with reference to dry matter) was crude protein, 28.45%; crude fat, 19.30%; crude fiber, 3.50% and total mineral (ash), 11%. The CHO,Ca was 38% and the gross energy (Kcal/Kg) was 2728.

Physico-chemical analysis of water

The temperature of the tanks, raceways and ponds was recorded twice daily (at 8 am and 4 pm) by using common laboratory thermometer. Other water quality parameters *i.e.*, pH, dissolved oxygen (DO), alkalinity, hardness and electrical conductivity (EC) were weekly recorded.

Data analysis

All the data was subjected to analysis of variance using MS Excel. Means having significant difference were separated through Duncan's Multiple Range Test by using statistical software M-Stat C.

RESULTS

Acclimatization

The average temperature recorded during experimental period in indoor fibreglass circular tanks and outdoor concrete raceways were 21.9±2.86°C and 22.7±3.49°C, respectively (Table I). Other physico-chemical parameters of water recorded during the experimental period in indoor fibreglass circular tanks and outdoor concrete raceways were within normal range.

Table I.- Water quality parameters recorded in indoor circular tanks and outdoor raceways (Sep 2003-Dec 2003)*

Parameters	Circular tanks	Raceways
Temperature (°C)	21.9±2.86	22.7±3.49
DO (ppm)	6.2±0.60	5.6±0.14
pH	8.0±0.00	8.0±0.05
Alkalinity (ppm)	202.9±21.42	210.6±3.55
Hardness (ppm)	231.0±9.02	214.3±14.61
EC µs/cm	386.2±3.53	421.4±6.44

*Values are Means±S.D.

During transportation of approximately 26 hours from Thailand to Pakistan, 5% mortality occurred due to leakage of oxygen from a few polyethylene bags. On first day 4% mortality

occurred during the first five hours after stocking the fish to circular tanks and raceways. The rate of mortality was higher during first hour after stocking

Table II.- Performance of channel catfish in indoor circular tanks and outdoor raceways during acclimatization fed on imported floating diet from September to December*

Days	Circular tanks			Raceways		
	Weight (g)	Wt. gain (g)	SGR	Weight (g)	Wt. gain (g)	SGR
0	10.86±1.20			10.56±0.68		
I5	19.60±1.54	8.74 ± 0.58^{aB}	3.94 ± 0.37^{aA}	20.26±1.27	9.70 ± 0.71^{aA}	4.35 ± 0.30^{aA}
30	27.91±1.54	8.31 ± 0.33^{bB}	2.36 ± 0.49^{bB}	28.42±1.41	8.16 ± 0.23^{bB}	2.26 ± 0.25^{bB}
45	33.03±2.68	5.11 ± 0.43^{cD}	1.12 ± 0.23^{cCD}	35.86±1.09	7.44 ± 0.38^{cC}	1.55 ± 0.23^{cC}
60	36.78±1.93	3.76 ± 0.25^{dE}	0.72 ± 0.17^{dDE}	39.36±0.88	3.49 ± 0.19^{dE}	0.62 ± 0.13^{dEF}
75	38.08±1.61	1.30 ± 0.29^{eG}	0.23 ± 0.06^{eF}	41.81±0.92	2.45 ± 0.29^{eF}	0.40 ± 0.06^{eEF}
		$27.21\pm0.38_{B}$	1.67 ± 0.26^{b}		31.25 ± 0.36^{A}	1.84 ± 0.19^{a}

Values are means±S.D.
SGR (Specific growth rate): [(ln Wf – ln WI) × 100]/days.
§means with different small superscript in each column and with cap superscript in each row within parameter differ significantly (P<0.05).

Table III.- Physico-chemical parameters of channel catfish ponds water recorded during the whole study period (Dec 03 – Nov 04) at two different stocking densities (3000/ha and 3500/ha)

Months	Temperature (°C)			D/O (ppm)	pH	Alkalinity (ppm)	Hardness (ppm)	E.C (µs/cm)
	Min.	Max.	Mean					
December	12.0	22.0	17.0	5.1	8.0	171	141	745
January	13.0	22.0	17.5	4.7	8.0	166	122	655
February	13.5	23.0	18.3	5.7	8.0	181	117	466
March	17.0	24.0	20.5	5.4	8.5	140	135	440
April	19.0	26.0	22.5	6.8	8.0	130	105	455
May	21.5	31.0	26.3	4.4	8.0	170	135	462
June	25.0	31.0	28.0	4.2	8.5	140	110	412
July	25.0	34.0	29.5	4.0	7.5	115	140	420
August	25.0	34.0	29.5	4.4	8.0	103	115	377
September	24.0	35.0	29.5	3.8	8.0	170	185	326
October	17.0	34.0	25.5	5.9	8.5	185	136	732

*values are means.

the fish. These mortalities were recorded only in the fishes stressed due to leakage of oxygen. A total mortality of 6.6% (*i.e.* 2.5 % in tanks and 4.1% in raceways) was recorded during acclimatization period. Mortalities occurring in raceways were significantly higher (P<0.01) compared to those in tanks.

Performance of channel catfish during acclimatization period is presented in Table II. Weight gain by catfish was high in raceways than in tanks during acclimatization period of 75 days. Significant decrease (P<0.05) in weight gain and SGR was recorded with decreasing temperatures during acclimatization period in both tanks and raceways. No disease occurred during the acclimatization period.

Ponds culture

Different water quality parameters recorded during the experimental period from December, 2003 - November, 2004 are given in the Table III.

Monthly weight gain of channel catfish in ponds is given in the Figure 1. Comparatively higher growth was observed from May onwards and the trend continued till October, while growth was relatively slower and uniform during December to March in both stocking densities.

The weight gain/fish was higher (P<0.05) in low stocking density than higher stocking density

(Table IV). Relatively better FCR was recorded (P<0.05) for low stocking density (3000/ha) than higher stocking density (3500/ha). Survival and fish production/pond was not different between two

Table IV.- Weight gain, feed efficiency, FCR, survival and pond fish production of channel catfish under two different stocking densities (3000 and 3500/ha).

Stocking density	Initial wt. (g/fish)	Final wt. (g/fish)	Weight gain (g/fish)	Feed Consd. (g/fish)	FCR	Fish Stocked	Fish Survived	production / Pond (Kg)
3000/ha	42.6± 6.5	1305.9±72.0	1263.3±60.9[a]	2223.2±68.0[b]	1.8±0.4[b]	120	115±1	144.0±17.0[a]
3500/ha	43.1± 5.1	1228.0± 85.2	1184.9±57.1[b]	2536.2±71.1[a]	2.1±0.5[a]	140	132±3	156.4±17.8[a]

*values are means±S.D.

§means with different superscript in each column differ (P<0.05).

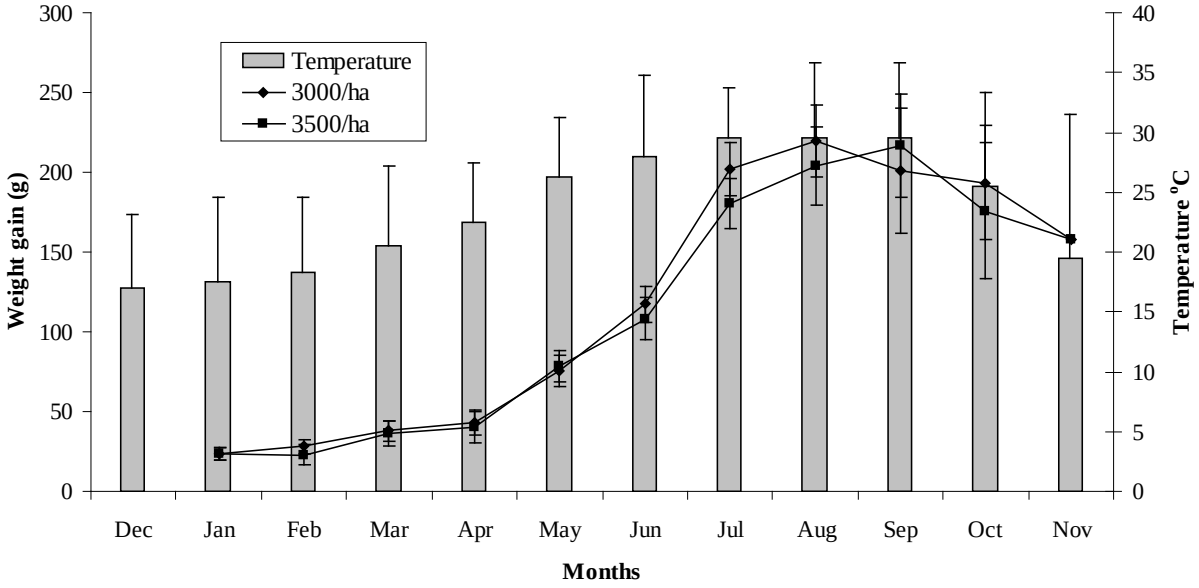

Fig. 1. Monthly weight gain of channel catfish in ponds stocked at two different stocking densities (3000/ha and 3500/h) over a period of one year.

stocking densities (P>0.05) although numerically better pond production was observed in high stocking density.

Maximum weight gain was recorded during July to September, when the average temperature was 29.5°C, whereas a low weight gain was recorded from December to March when the average temperature was below 19.5°C. From the month of April, weight gain took a steady rise when the average temperature rose up to 20°C. Highly positive correlation (P<0.01) was observed between temperatures and weight gain in both treatments (Fig. 1).

DISCUSSION

Acclimatization

Five percent mortality was recorded in the present study during 26 hrs transportation of channel catfish fingerlings due to leakage of oxygen from some of the polythene bags. An overall 6.6% mortality of was recorded during the acclimatization period *i.e.*, from September to December 2003 in

tanks and raceways, which might be due to environmental stress such as low temperature, as the optimum temperature for the growth of channel catfish is 26-30ºC (Buentello *et al*., 2000).

Comparison of growth performance of channel catfish fingerlings during acclimatization in tanks and raceways showed a gradual increase in weight gain. The weight gain achieved during the present study was comparatively lower than that reported in some other studies (Gaylord and Gatlin, 2001**;** Li *et al*., 2003). The low growth rate in the present study might be due to lower temperature during acclimatization period as optimum water temperature for the growth of channel catfish is 26-30ºC (Buentello *et al*,. 2000).

All the Physico-chemical parameters of water recorded during the experimental period were under suitable range as reported by Wellborn (1988) and Morris (1993) except temperature. The better growth achieved in the raceways compared to the circular tanks in present study might be due to the difference in water volume, rate of water circulation and daylight among them (Buentello *et al*., 2000).

Pond culture

All the physico-chemical parameters of water recorded during the experimental period were under suitable range for pond culture of channel catfish as reported by Buentello *et al*. (2000), Durborow (2000) and Rezk *et al*. (2003). In the present study two stocking densities (3000 and 3500/ha) were tested under local environmental condition in ponds to observe growth of channel catfish. Two stocking densities tried did not differ in survival and total fish production/pond. This might be due to low difference in two stocking densities. Our results showed that fish stocked with low stocking density of 3000/ha had a higher weight gain, high feed conversion and better survival as compared to fish stocked at a high density of 3500/ha. Our results are consistent with that of Li *et al.* (2003), who reported that when stocking density increases grass production increases, and feed efficiency, weight gain per fish and survival decrease. The stocking density 20,000 to 40,000 fry / ha, practice in the home land of channel catfish is much higher (Chapman, 2000) than that studied in the present trials. There is need to investigate that type stocking density in our environment.

In present study maximum growth was recorded from April to October providing 210 days growing period. Studies conducted in USA reported that growing period of channel catfish is from April to October (Robinson and Li 1999; Li *et al.*, 2003). The growth achieved in pond during one year in present study was comparatively better than that recorded by Robinson and Li (1999) and Li *et al.* (2003) in two growing seasons, however the stocking densities in their studies were much higher (18,530 fish/ha) than once in our study. In our study fish were fed to satiation on a dietary protein of 30% and the resulting FCR for both stocking densities was almost similar that recorded by Robinson and Li (1999) and Engle and Stone (2002).This might be due to the reason that sinking diet was used in present study and some portion of it might have wasted during satiate feeding.

It is concluded that channel catfish fingerlings perform better in outdoor raceway than indoor tanks during first 75 days. Later on growth rate in ponds at two stocking densities (3000 vs. 3500 /ha) did not differ from each other over a period of one year.

ACKNOWLEDGEMENT

Work was funded by Agriculture Linkages Programs (ALP), sponsored by United States Department of Agriculture (USDA) and Pakistan Agriculture Research Council (PARC). The authors would like to thank Cold Water Research Station, Chiang Mai Province, Thailand for providing channel catfish fingerlings.

REFERENCES

BASAVARAJA, N., MAHESH, T., GIRESSHA, O MALLESHAPPA, H.D. AND VARGHESE, T.G., 1999. Carp seed production in Karnataka (India). *Aquacul. Asia, NACA*, **4**: 16-20.

BUENTELLO, J.A., GATLIN III, D.M. AND NEILL, W.H., 2000. Effects of water temperature and dissolved oxygen on daily feed consumption, feed utilization and growth of channel catfish (*Ictalurus punctatus*). *Aquaculture*, **182**: 339–352.

CHAPMAN, F.A., 2000. *Farm-raised catfish*. Department of Fisheries and Aquatic Sciences, Florida Cooperative Extension Service, Institute of Food and Agricultural

Sciences, University of Florida. Circular no: 1052.

DURBUROW, R.M., 2000. *Catfish farming in Kentucky*. Kentucky State University Aquaculture Program; The Kentucky Department of Agriculture and the National Oceanic and Atmospheric Admanistration. pp. 1-112.

ENGLE, C., 2003. The evolution of farm management, production efficiencies, and current challenges to catfish production in the United States. *Aquacul. Econ. Managem*., **7**: 67-84.

ENGLE, C.R. AND STONE, N., 2002. Costs of small-scale catfish production. United States Department of Agriculture, Cooperative State Research, Education, and Extension Service. SRAC Publication No. 1800.

FAO, 2006. *Introduced species database*. FIGIS. 1-3. www.fao.org/figis.

GAYLORD, T. G. AND GATLIN III, D. M. 2001. Dietary protein and energy modifications to maximize compensatory growth of channel catfish (*Ictalurus punctatus*). *Aquaculture*, **194**: 337-348.

HILGE, V., 1981. Some aspects on recent developments in the research on fish reproduction. In: *Intensive aquaculture*. European Mariculture Society, Bredene, Belgium, Special Publication No. 6, 229p.

JENSON, J. AND CREWS, J., 1997. *Channel catfish production in ponds*. Alabama Cooperative Extension System. ANR-195.

LI, M.H., MANNING, B.B., ROBINSON, E. H. AND BOSWORTH, B.G., 2003. Effect of dietary protein concentration and stocking density on production, characteristics of pond-raised channel catfish *lctalurus punctatus*. *J. World Aquacul. Soc*., **34**: 147-155.

MORRIS, J.E., 1993. *Pond culture of channel catfish in the north central region*. Department of Animal Ecology, Iowa State University, Ames, Iowa. North Central Regional Extension Publication No. 444. 1-6pp.

REZK, M. A., SMITHERMAN, R.O., WILLIAMS, J.C., NICHOLS, A., KUCUKTASA, H. AND DUNHAM, R.A., 2003. Response to three generations of selection for increased body weight in channel catfish, *Ictalurus punctatus*, grown in earthen ponds. *Aquaculture*, **228**: 69–79.

ROBINSON, H.E. AND LI, H.M., 1999. Effect of dietary protein concentration and feeding rate on weight gain, feed efficiency, and body composition of pond-raised channel catfish *Ictalurus punctatus. J. World Aquacul. Soc*., **30**: 311-318.

TUCKER, C. S. AND HARGREAVES, J.A., 2003. Management of effluents from channel catfish (*Ictalurus punctatus*) embankment ponds in the south-eastern United States. *Aquaculture*, **226**: 5 –21.

WELCOMME, R. L., 1988. *International introduction of inland aquatic species*. FAO, Fish.Tech. Paper, 294: 318 pp.

WELLBORN, T.L., 1988. *Channel catfish: life history and biology*. Southern Regional Aquaculture Centre. SARC publication number, 180. 1p.

(Received 13 February 2007, revised 29 May 2007)