Productivity enhancement through probiotic and zeolite in fish culture practices in *Tarai* region of Uttarakhand

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ABSTRACT: Water quality is the fore most important limiting factor in pond fish production, so zeolites are used in aquaculture with the aim to provide pollution control, remove N-compounds, increase oxygen level and an ideal means of managing ammonia levels in aquaculture system. As far as feed of fish is concern, to maintain feed quality, probiotics are used. These probiotics increase the population of fish food organisms, improve the nutrition level and improve immunity of cultured animals to pathogenic micro-organisms. Considering the importance of zeolite and probiotics to enhance the water quality and feed quality respectively for fish culture, field trials were conducted on farmer's field in 5 different locations of district Udham Singh Nagar (Uttarakhand) for consecutive two years on an average 1.0 acre ponds. The parameters related to fish feed and water quality were studied during the course of investigations. Treatment of zeolite @ 50 kg/acre at the time of pond preparation and 20 kg/acre after three month interval were applied for improvement of water quality, while use of probiotic (*Lactobacillus sporogenes*)@ 1 kg/ton were applied in feed to enhance the feed quality. These treatments were compared with farmer practice i.e. use of lime @ 250 kg/ha and ordinary feed. The analysis of data indicated that there was not only a significant difference in fish yield (i.e.19.04 %) as compared to lime and ordinary feed but also in term of vigorous growth with high benefit cost ratio. The higher benefit cost ratio (i.e. 7.37) was achieved in treated ponds in comparison to local practices (i.e. 6.65 B: C ratio).

Key words: Benefit cost ratio, economic status, fish culture, probiotic, water quality, zeolite

Water quality determines the ultimate success or failure of aquaculture system. Among all the water quality parameters which affect fish, ammonia is the most important after oxygen. Ammonia at relatively low concentration can have negative effects on fish tissues and physiological factors such as growth rate, oxygen consumption and disease resistance which can restrict yields in fish culture. When ammonia accumulates to toxic levels, fish cannot extract energy from feed efficiently. If the ammonia concentration gets high enough, the fish will become lethargic and eventually fall into a coma and die (Asgharimoghadam *et al*., 2012). The main source of ammonia in fish ponds is fish excretion. The rate at which fish excrete ammonia is directly related to the feeding rate and the protein level in feed. As dietary protein is broken down in the body, some of the nitrogen is used to form protein (including muscle), some is used for energy, and some is excreted through the gills as ammonia. Thus, protein in feed is the ultimate source of the most ammonia in ponds where fish are fed. Another main source of ammonia in fish ponds is diffusion from the sediment. Large quantities of organic matter are produced by algae or added to ponds as feed. Fecal solids excreted by fish and dead algae settle to the pond bottom, where they decompose. The decomposition of this organic matter produces ammonia, which diffuses from the sediment into the water column (Hargreaves and Tucker, 2004).

Probiotics" generally includes bacteria, cyanobacteria, micro algae, fungi, etc. it includes photosynthetic bacteria, *Lactobacillus, Actinomycetes, Nitrobacteria, Denitrifying* bacteria, *Bifidobacterium*, yeast, etc. Probiotic bacteria are generally called the bacteria which can improve the water quality of aquaculture and inhibit the pathogens in water thereby increasing production. Recently, the bio-controlling theory has been applied to aquaculture. Many researchers attempt to use some kind of probiotics in aquaculture water to regulate the micro-flora of aquaculture water, control pathogenic microorganisms, to enhance decomposition of the undesirable organic substances in aquaculture water and improve ecological environment of aquaculture (François-Joël, 2005). In addition, the use of probiotics can increase the population of food organisms, improve the nutrition level of aquacultural animals and improve immunity of cultured animals to pathogenic microorganisms (Nayak, 2010). The use of antibiotics and chemicals can be reduced and frequent outbreaks of diseases can be prevented (Rico *et al*., 2012).

The present investigation was conducted to determine the combined effects of probiotics, *L. sporogenes* and zeolite on survival, growth and yield in composite fish culture.

MATERIALS AND METHODS

The present study was conducted on farmer's field in 5 different locations of district Udham Singh Nagar (Uttarakhand) on average 1.0 acre ponds. Ponds were prepared by application of cow dung @ 10 ton/ ha before one month of stocking of fingerlings followed by application of lime @ 250 kg/ ha after 15 days gap as farmers practice, in addition to that dose of zeolite @ 125 kg/ha at the time of pond preparation administrated in experimental ponds. Zeolites contain 75-80 % SiO_2, 14-18 % Al_2O_3 1-3 % Fe_2O_3 2-5 % CaO, 1-3 % MgO and 1-2 % Na_2O. A total number of 5,000 fingerlings of Indian major carps and exotic species (i.e 750 fingerlings of each fish species i.e. Catla, Mrigal, Silver Crap, Grass carp in 1.5 ratio while 1000 fingerlings of Common carp and Rohu each in 2.0 ratio) were stocked in pond.

Fishes were fed with a mixture of rice bran and oilcake in equal quantities daily as farmer's practice while in case of experimental ponds fish, feed was enriched with probiotic bacteria (*Lactobacillus sporogenes)* @ 1.00 kg/ ton. One kg of probiotics contain 33,200 million cfu *Lactobacillus sporogenes*, 5320 mg liver extract, 1250 mg yeast extract (*Saccharomyces cervisiae*), 5000 mg alpha amylase, 500 mg ascorbic acid coated, 100 g proteins and 5320 mg spirulina etc.

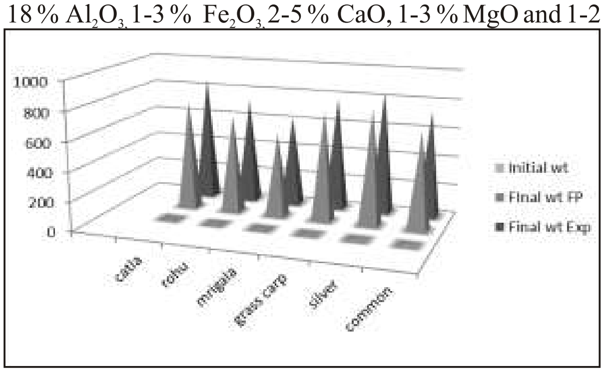

Fig. 1: Analysis of growth parameters initial weight and final weight

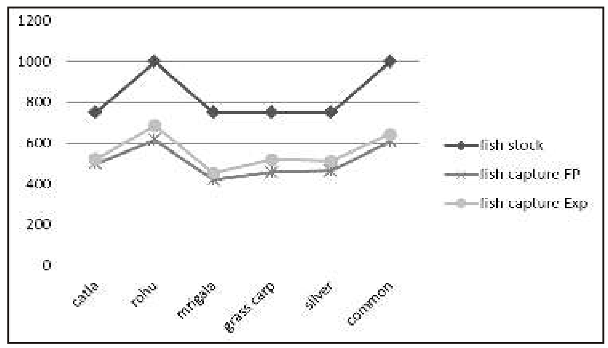

Fig. 2: Total number of fish captured compared to fish stocked

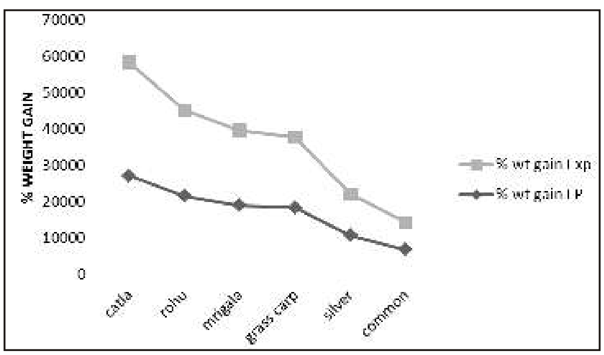

Fig. 3: Difference of percentage weight gain

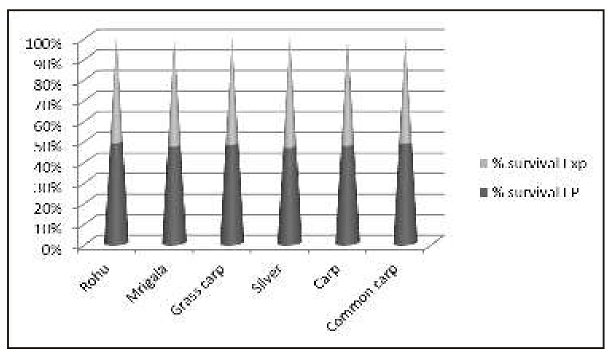

Fig. 4: Percentage survival of fish stock

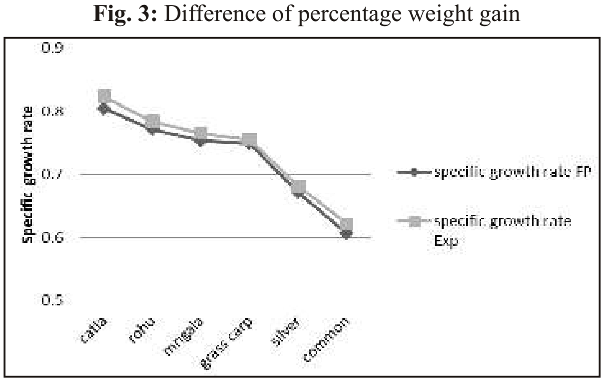

Fig. 5: Evaluation of specific growth rate of different fish species

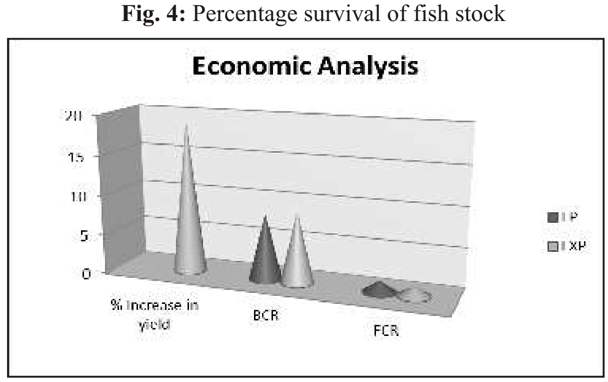

Fig. 6: Economic analysis of experimental trail compared to farmer's practice

After three months interval experimental ponds were again subjected to the application of zeolite @ 50 Kg/ha. A total quantity of 3200 ± 45.18 kg of supplement feed was given in each trial during the culture period of 303 days. After the trial, survival rate (SR), weight gain (WG), specific growth rate (SGR), feed conversion rate (FCR) and other parameters were determined by the following equations. The collected data were analyzed and compared with the farmers practice.

SR (%) = Total no. of live fingerlings/Total no. of initial fingerlings X 100

WG (g) = Final weight gain - Initial weight

SGR (%) = logW2-logW2/t X 100

(Where W1 & W2= initial and final weight respectively (gm) t= total no of experimental days)

FCR = Total feed given/total weight gain

RESULTS AND DISCUSSION

Data concerning the various growth parameters are presented in Table 1. The results showed there were significant increase at 5% level in the final weight of fingerling in reference to *catla* 998±96g in experimental trials against 748±45g as farmers' practice, rohu 822±73g against 672±65g, mrigal 756±78g against 576±68g, grass carp 924±84g against 747±76g, silver carp 1110±78g to 792±80g and common carp 861±68g to 662+85g compared to farmer's practice. Among all cultured carp, silver carp showed maximum growth in both cases. There was a significant increase the survival of fingerlings as 66.90% in experimental trials compared to 61.40% in farmers' practice. Data also showed increase in specific growth rate in experimental trails (i.e. 0.74%) compared to 0.73% in case of farmers' practice. After complete harvesting of pond (by repeated netting and dewatering), there was an increase of 19.04% in yield resulted the fish production of 6383.04 Kg/ha in experimental tank as compared to the 5361.90 kg/ha in farmers' practice. Economic analysis of both trials was showed (Table-2) the cost of cultivation in farmers' practice was Rs 56,000.00 only while in case of experimental trial it was Rs 61,000.00 only. The food conversion ratio (FCR) was 1.49 in case of farmers' practice while in case to the experimental trails reduces to 1.25, high benefit cost ratio i.e. 7.37 was achieved in experimental trails as compared to 6.65 benefit cost ratio in farmer's practice.

The present study reveals that the zeolite and probiotic enhance the water condition in ponds and facilitate the better absorption and utilization of energy as feed. Rico *et al.* (2012) also reported the importance of zeolites and probiotics in fish culture. The presence of bacteria producing inhibitory substances in the intestine of the host, on its surface or in its culture medium is thought to constitute a barrier against the proliferation of (opportunistic) pathogens (François-Joël, 2005). Garyb and Steverni (2005) have reported microbial processes in aquaculture environment and their importance in increasing crustacean production. Balcázara, *et al*. (2006) reported the antibacterial abilities of intestinal bacteria in freshwater cultured fish. In aquaculture practices, application of zeolite is suggested in ponds before stocking fry or during pond preparation (Briggs and Funge-Smith, 1996). Jiravanichpaisal *et al*. (1997) reported the use of *Lactobacillus* spp. as the probiotic bacteria in the giant tiger shrimp (*P. monodon fabricius*). Probiotics are live microbes that can be used to improve the host intestinal microbial balance and growth performance. Michael *et al.*(2014). The benefits of such supplements include improved feed value, enzymatic contribution to digestion, and inhibition of pathogenic

Table 1: Analysis of growth parameters

Species	Fish stock	Initial wt (gm)[A]	Final wt (gm)[A]	Final wt (gm)[A]	Fish capture (gm)		Final yield kg/ha		% wt gain		% survival		Specific growth rate		% increase\
			FP	Exp	FP	Exp	FP	Exp	FP	Exp	FP	Exp			
Catla	750	2.74+.68	748+45	998+96	501	524	374.75	448.54	27199.30	31140.90	66.80	69.87	0.80	0.82	19.69
Rohu	1000	3.09+1.25	672+65	822+73	616	687	413.95	502.88	21647.60	23589.30	61.60	68.70	0.77	0.78	21.48
Mrigala	750	3.01+1.08	576+68	756+78	421	455	242.50	284.38	19036.20	20664.10	56.13	60.67	0.75	0.76	17.27
Grass carp	750	4.02+0.68	747+76	924+84	458	521	342.13	406.38	18482.10	19303.00	61.07	69.47	0.75	0.76	18.78
Silver carp	750	7.33+1.60	792+80	1110+78	465	513	368.28	435.02	10704.90	11468.90	62.00	68.40	0.67	0.68	18.12
Common carp	1000	9.64+1.51	662+85	861+68	609	645	403.16	476.01	6767.22	7555.60	60.90	64.50	0.61	0.62	18.07
Total	5000				3070	3345	2144.76	2553.22	17306.21	18953.60	61.40	66.90	0.73	0.74	19.04

A: Mean+ SD, FP: farmer's practice, Exp: Experimental trials

Table 2: Economic analysis of trials

Treatments	Yield (Kg/Ha)	Cost of cultivation (Rs/ha)	Gross return (Rs)	Net return (Rs)	% yield increase	BCR	FCR
Farmers' practice	5361.9	56000	428952	382952	-	6.65	1.49
Exp	6383.0	61000	510643	459643	19.04	7.37	1.25

microorganisms, anti-mutagenic and anti-carcinogenic activity, and increased immune response Pandiyan *et al*.(2013).

Emadi *et al*. (2001) reported in their study that zeolite has great potential for removing ammonia from water while Obradovic *et al*. (2006) emphasized the role of zeolite as a feed additive also had a simulative effect in daily feed consumption and nutrition. Fachini and Vasconcelos (2006) reported that zeolites have been capable of stimulating the growth of the silicon-demanding micro-algae, like diatoms mainly because they can act as a silicon buffer in water. When the probiotic bacterial strains were added to the larval culture water, the survival rate and the abilities of disease resistance were improved, average body length and weight were also increased (Wang, *et al.,* 2010).

From this investigation, it can be concluded that addition of zeolite along with probiotic as feed additives "alternative growth promoters" by small amounts increase the fish production significantly. Zeolite is cheaper and does not need conditioning before use this makes use of zeolite in fish culture facilities a better option for reducing ammonia concentration. The use of probiotics as growth promoter as well as biological control agents should be considered to be a kind of risk insurance that may provide any notable benefit when the culture is performing under optimal conditions and in the absence of (opportunistic) pathogens but that will be very helpful if infectious diseases break out.

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