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UTILISATION OF VEGETABLE LEAVES FOR CARP PRODUCTION

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ABSTRACT

The results of two sets of experiments on mono-culture of grass carp *(Ctenopharyngodon idella)* and mixed culture of carps (grass carp 50 : catla 20 : rohu 15 : mrigal 15) fed exclusively with vegetable leaves are reported. The experiments were conducted with two replicates each in 0.02 ha ponds of Wastewater Aquaculture Division of the Central Institute of Freshwater Aquaculture, Rahara during 1991-93.

Monoculture of grass carp stocked @ 1000/ha demonstrated an average net production of 21.0 kg/ 0.02 ha/8 months (1501 kg/ha/yr). Mixed culture of carps stocked @ 5000 /ha recorded an average net production of 22.5 kg/0.02 ha/8 months (1903.7 kg/ha/yr). Field studies revealed that water bind weed *(Ipomoea aquatica)* is the most preferred feed of grass carp amongst vegetable leaves followed by amaranths *(Amaranthus gangeticus* and *Amaranthus viridis),* cauliflower *(Brassica oleracia* var. *votrytis)* and cabbage *(Brassica oleracia* var. *capitata)* leaves. Through selection of highly productive leaf vegetables and suitable crop planning on fallow fish pond dykes, round the year feeding programme of grass carp has been explored. Recycling of sewage effluent for vegetable production and utilisation of vegetable leaves for fish production is considered an ideal way of integrated resource management for low cost production.

INTRODUCTION

In the recent past attention has been given to integrated farming system for optimum utilisation of resources in order to reduce the cost of cultivation. Integration of fish culture with domestic sewage effluent has been found to be economic. Further utilisation of sewage fed pond dykes through vegetable and fruit cultivation has enabled reduction of recurring expenditure of farm maintenance thereby adding to the revenue of integrated farming. During the course of experimental studies during the past years at Wastewater Aquaculture Division, Rahara, on the utilisation of pond dykes through vegetable cultivation, it has been observed that a huge quntity of vegetable leaves of cabbage, cauliflower, radish and amaranth are thrown away during periodical thinning or during final harvest. With this background in mind it was thought of utilising these waste leaves as feed of grass carp for productive purposes enabling the complete cycle of

integration. A number of reports are available on the growth and production of grass carp fed with different aquatic weeds (Alikunhi and Sukumaran, 1964; Alikunhi *et al.,* 1971; Chakraborty *et al.,* 1979; Hickling, 1967; Sreenivasan and Rao, 1979; Patra *et al.,* 1979; Sinha & Gupta, 1975 and Singh, 1989). The only information available is on a preliminary study of one month duration conducted at Cuttack on the growth of grass carp when fed with guinea grass, leaves of cauliflower, cabbage and *Ipomoea cornea* (Jhingran, 1991). The present study was planned for utilisation of vegetable leaves, grown on pond dykes, as feed of grass carp and resultant production from monoculture of grass carp and mixed culture of carps with grass carp as a major component species. Growth survival and production of grass carp, vegetable leaf preference and conversion ratio are also dealt with in this communication.

MATERIALS AND METHODS

Two sets of experiments each with two replicates were conducted in ponds (0.02 ha) of uniform size and shape of wastewater Aquaculture Division of Central Institute of Freshwater Aquaculture, Rahara, during 1991-1993. The first set of monoculture of grass carp experiment was conducted from 26.11.91 to 24.7.92 and the second on mixed culture of carps with grass carp as major component from 27.11.92 to 28.11.92. Initially the ponds were dewatered, cleaned, all the fishes removed and sundried for about a week and then filled with freshwater. Grass carp reared in a neighbouring pond of this farm was stocked @ 1000 /ha in two ponds. In mixed culture the stocking density was 5000 /ha and species ratio was grass carp 50 : catla 20 : rohu 15 : mrigal 15. During the entire period of experiments of both the sets feeding were done exclusively with leaves of Amaranth, *(Amaranthus viridis)* cauliflower *(Brassica oleracia* var. *votrytis),* cabbage *(Brassica oleracia* var. *capitata)* and radish *(Raphanus sativum)* and leafy vegetables like water bind weed *(Ipomoea aquatica)* and amaranth *(Amaranthus gangeticus)* depending on the seasonal cultivation practices. Leaves of vegetables were given daily excepting holidays @ 50% of body weight for first four months and @ 25% of body weight during the rest four months of culture duration. Quantity of leaves to be given in each pond was determined based on monthly assessment of growth of the fishes through sample netting. Lime were applied to the ponds prepartion and latter on at the mid of the experiments. Temperature, pH, DO, Phosphate and nitrogen of water phase were recorded monthly. Feed preference studies were done by giving different kinds of vegetable leaves at fixed proportion of biomass of grass carp in the ponds and then by observing the quantity consumed in a fixed period. At the end of the experiments the water level of the ponds were reduced by pumping out water and the entire fishes were caught by repeated netting and recorded the growth, survival and production. Conversion ratio has been calculated as the ratio of quantity of leaves given is to weight gain in flesh.

RESULTS AND DISCUSSION

During the course of entire study the temperature, DO and pH of water ranged between 20 & 33°C, 1.2 & 5.2 ppm and 7.4 & 8.5 respectively. Levels of phosphate and nitrate ranged from 0.2 to 0.8 ppm and 0.3 to 2.8 ppm respectively. Summary of stocking, harvesting, survival and production of monoculture and mixed culture experiments are presented in Table 1 and Table 2 respectively. It is well known that grass carp is a voracious feeder on aquatic and terrestrial vegetation. Therefore, the growth of the fishes depend on the availability of the weeds. In the present experiments feeding (25 to 50% of body weight) with leaves of vegetables and leafy vegetables to grass carp stocked @ 1000/ha acheived an average gross and net productivity of 26.0 kg/0.02 ha/8 months (1950.7 kg/ha/yr) and 20.0 kg/0.02 ha/8 months (2819.2/ha/yr) and 22.4 kg/0.02 ha/8 months (1903.7 kg/ha/yr) (Table 2). Most significant aspect of both the sets of culture experiments is that these level of productions were achieved through feeding the grass carp exclusively with leafy vegetables and leaves of vegetables which are considered as waste and usually thrown away during harvest. Stocking sizes of the grass carps are quite larger in monoculture and large in mixed culture (Tables 1 & 2); therefore grass carp consumed vegetables leaves directly and other carps perhaps grew on the semi-digested food which serves both as feed for bottom-dwelling fishes and pond fertilizer. Production of grass carp fed on aquatic weeds when stocked @ 4000/ha with grass carp 50% and 10% each of catla, rohu, mrigal, silver carp and common carp was reported to be 313 kg/0.07 ha/yr (Jhingran, 1991). It is reported that grass carp of length greater than 30 mm is almost exclusively a vegetaterian (Nikolski, 1956). It is further observed that larger fishes are able to masticate the leaves of tough land plants and fibrous grass (Hickling, 1966). In China the fish has been reported to consume 40 to 70% of its own weight of grass per day. Therefore, in the present experiment on grass carp, selection of items of vegetable and rate of feeding seems to be in the right direction. Average growth of grass carp from monoculture and mixed culture have been found to be 4.2/day and 1.7 /day respectively in the present experiments. Daily average growth of grass carp and catla have been reported to be 3.7 and 2.1g respectively from mixed culture of these two species when fed with *Hydrilla, Vallisneria* and *Najas* (Alikunhi *et al.*, 1971). In another study o f 100 days duration, using *Ruppia, Maritima* and *Najas minor* increment have been found to range from 19.8g to 32.2g./day. Average increment of grass carp cultured using Hydrilla from compotiste fish culture experiments were found to range from 4.3 to 26.5 g/day under different treatment conditions (Anon, 1983). Average weight increment of grass carp from various composite culture experiments were observed to be 5.6/day (Tripathi and Datta, 1990). Average survival rate for monoculture was observed to be 100% and that for mixed culture was 92% which are highly satisfactory. Average percentage

Table 1 : *Summary of experiments on monoculture of grass carp fed exclusively with vegetable leaves during 26.11.1991 to 24.07.1992.*

Pond	No. stocked	Average size mm/g	No. harvested	Average size mm/g	production Gross (kg)	production Net (kg)	Survival (%)
Pond-1		308.1		502.6			
(0.02 ha)	20	285.1	20	1414.0	28.3	22.6	100
Pond-2		320.8		473.3			
(0.02 ha)	20	314.6	20	1187.0	23.7	17.4	100
Average	-	-	-	-	26.0	20.0	100
Av.Prod ha/8 months	-	-	-	-	1300.5	1000.6	-
Av. Prod ha/yr.	-	-	-	-	1950.7	1501.0	-

Table 2 : *Summary of experiment (no 2) on mixed culture of carps fed with vegetable leaves during 27.11.1992 to 28.07.1993*

Pond	Name of species	Stock		Harvest		Survival (%)	Gross (kg)	Net (kg)
		No stocked	Average size mm/g	No harvested	Average size mm/g			
Pond 1 (0.02 ha)	Grass carp	50	231.2	48	362.0	96.0	28.4	21.4
	Catla	20	183.8	20	272.9	100.0	4.8	2.6
	Rohu	15	196.0 100.0	14	267.3 200.0	93.3	2.8	1.4
	Mrigal	15	239.0 120.0	13	330.7 342.7	86.7	4.4	2.9
	Total	100		95			40.4	28.3
Pond 2 (0.02 ha)	Grass carp	50	225.0 140.0	45	360.0 522.0	90.0	23.5	17.2
	Catla	20	180.5 100.0	18	260.0 252.2	90.0	4.5	2.7
	Rohu	15	266.0 196.0	13	319.4 277.3	86.7	3.6	1.05
	Mrigal	15	240.1 122.0	13	295.0 237.7	86.7	3.1	1.5
	Total	100		89			34.7	22.5
	Average			92			37.6	25.4
	Av prod ha/8 months	-		-		-	1879.5	1269.1
	Av. prod. ha/yr.	-		-		-	2819.2	1903

contribution to total net production in about 76% by grass carp compared to the stocking number of 50% (Table 2). Composite fish culture experiments under the Co-ordinated Research Project on Composite culture of indigenous and exotic carp showed that percentage contribution to production by weight was much more by exotic carps than their percentage in number. It was also observed that the growth of grass carp depended predominently on the availability of weeds (Jhingran, 1991). But due to the shortage of aquatic weeds this species cannot be dropped from the composite culture. Therefore, the search for alternative items continued with vegetable leaves.

Studies on feed preference (among vegetable leaves) have indicated that water bind weed is the most preferred followed by amaranth *(A. viridis),* amaranth *(A.gangeticus),* cauliflower, cabbage and radish leaves. Leaves of Indian spinach are also consumed by grass carp but the fish seems to be in distress. During preliminary screening of feed at Cuttack it was observed that fingerlings of grass carp fed with guinea grass, leaves of cauliflower, cabbage and *Ipomoea carnea* at a feeding rate of 100g/ day gained an average weight of 28.5g, 25.0g, 14.0g and 3.6g respectively in one month compared to 1.9g registered by the control.

Conversion factors of aquatic weeds given to grass carp were reported to be 22:1 *(Vallisneria)*, 20.5:1 *(Najas)* and 17.8:1 *(Hydrilla)* (Alikunhi *et al.,* 1971) In the present study average conversion has been found to be 46.2:1 and 54.6:1 from mixed and mono culture respectively, compared to 45.5:1 reported by Tripathi (1993).

In an attempt to explore the possibility of feeding grass carp round the year with vegetable leaves for sustained yield, proper crop planning and requirement of dyke area for cultivation for continuous supply of feed in mono or mixed culture has been worked out. A record production of 89.5ton/ha/yr has been reported from a dyke of Wastewater Aquaculture Division of CIFA, out of which leafy vegetable and leaves of vegetable constitute the major portion (Rai *et al.,* 1993). Production potential of some of the highly productive vegetables, which are preferred by grass carp, their duration of cultivation and worked out dyke area required for cultivation of vegetable leaves for regular supply in mono and mixed culture ponds at densities tried in the present experiments are given in Table 3.

Water bind weed and amaranth can be fed to grass carp during March to September (Table 3). Most advantageous feature of these two leafy vegetables is that these are harvested partially by clipping, leaving the roots which again become ready for next harvest within two to three weeks time. At the time of sowing, the entire plot may be subdivided into 25-30 subplots so that harvest from each subplot can be fed to grass carp in cyclic order. Similarly, during September to February, grass carp can be fed with leaves of cauliflower, cabbage and radish. It has been observed that leaves weighing equivalent to one-third of total

Table 3 : *Production rate**, crop duration** and dyke area requirement for vegetable cultivation for regular feed to grass carp*

Name of the vegetable	Crop duration (days)	Production/ ton/ha/crop.	Dyke area requirement for vegetable cultivation (ha)	
			For mono-culture of carp @ 1000/ha	For mixed culture of carps @ 5000/ha
Water bind weed *(Ipomoea aquatica)*	April to September (180)	104.1	.3890	4171
Amarnth *(Amaranthus viridis)*	March to August (160)	120.3	3590	.3856
Amaranth *(Amaranthus gangeticus)*	January to March (40)	12.0	.9000	.9667
Cauliflower *(Brassica oleracia* var. *votrytis)*	September to December (85)	23.6	2.9189	3.1351
- Do -	November to February (80)	35.6	1.8206*	1.9555
Cabbage *(Brassica obracia* var. *capitata)*	September to December (90)	24.4	3.0000*	3.2200
- Do -	December to February (85)	37.7	1.8206*	1.9621
Radish *(Raphanus sativum)*	November to January (65)	18.5	2.8723**	2.0851

* *Dyke area requirement has been calculated assuming that leaves about one third of equivalent weight of production is available as feed for grass carp.*

** *Reproduced from Rai et al., 1993.*

production of these three vegetables are generally thrown away during thinning and cleaning operations or during final harvest. Cultivation of the above mentioned few crops on pond dykes may enable regular supply of vegetable leaves as feed of grass carp round the year. Another advantageous point in selecting these vegetables is that these are not generally found to be affected by any disease or pest in this ecosystem requiring use of pesticide. Dyke area requirement for growing these vegetables for regular supply of vegetable leaves in monoculture and mixed culture at densities and rates of feeding used for achieving the present growth rate have been estimated. It has been worked out from the present experimental data that on an average 1080 kg and 1160 kg of leaves were given to grass carp in mono and mixed culture ponds (10.02 ha) respectively during the entire culture duration of eight months. Based on these, average per day requirement is calculated (considering feeding for 25 days in a month). Now dividing the average per day vegetable requirement by average production rate per day will give the estimated required area. Table 3 indicates that 0.35 to 0.4 ha dyke area are required for cultivation of water bind weed and amaranth to enable regular supply of feed to grass carp in mono and mixed culture at densities tried in the present case. In case of cabbage, cauliflower and radish, as the leaf weight is about one-third of respective crops production rate, it takes about 1.4 to 3.2 ha area for feeding grass carp either in mono or in mixed culture as tried in the present case for achieving present level of production.

This study being first of its kind will help proper crop planning, resource utilisation of integrated farming involving sewage effluent utilisation for fish and vegetable production and further utilisation of vegetable leaves for carp production thereby completing the cycle of integration resulting in low cost productivity.

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