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THE VIABILITY DEGREE OF 15 DIFFERENT KINDS OF HYBRIDS PRODUCED BY PAIRING GAMETES FROM COMMON CARP, CHINESE CARP AND TENCH.

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ABSTRACT

Fertilization and hatching rates of the pure line species of common carp **Cyprinus carpio**; big head carp **Aristichthys nobilis**; grass carp **Clenopharyngodon idella**; silver carp **Hypophthalmichthys molitrix**; tench **Tinca tinca** and their different combination crosses were determined in addition to the heterosis values of these parameters.

No viable embryos produced from hybridization of males commom carp with females bighead; grass; silver carp and tench. The cross breeds of common carp females with bighead; grass; silver carp; and tench males showed significant lowering in the fertilization and hatching rates when compared with the pure line species. Cross-breeds of female bighead x silver carp male; female silver carp x bighead carp male; female grass carp x bighead male and female common carp x silver carp male exhibited better value for these parameter. Concerning the males of silver carp and bighead carp showed specific combining ability in fertilization and hatching rates when crossed with females common carp or grass carp.

INTRODUCTION

Hybridization in fish is a relatively recent innovation and is aimed to evolve a hybrid or strain of superior quality than the parent species. Thus the hybrids play an important role in fish culture. The Russians are the pioneers in the field of selective breeding and hybridization of fish (Kirpichnikov, 1938).

Hybridization among strains and sub-species has been played a part in genetic improvement of common carp. The hybrids of cultivated common carp with wild common carp from the river Amur, is called the "Kursh carp" and it is already known to have a greater resistance to cold temperature than the cultivated carp (Kirpicknikov, 1971).

There are many scientists working on the hybridization of these species and can produce viable larvae.

Alikunhi et al (1962) and Chaudhuri (1971) crossed grass carp with bighead and silver carp with bighead, but the embryo died before hatching, while Andriasheva (1966) and voropaev (1968) reported that the hybrids of silver and bighead carps showed increased survival rates at the larval stage and the fingerlings of these hybrids.

The intensive chromosome studies proved that common carp, chinese carp and tench, could be hybridized effectively (Bakos et al 1976; Marian and Krasznai 1977 and 1980).

The aim of the present study was to determine the fertilization and hatching rates for hybrids and the pure line species of common carp, chinese carp and tench. The heterosis values were also calculated for these parameters.

MATERIALS AND METHODS

Experiments of the present study were carried out at warmwater, fish hatchery research centre, TEHAG, SZAS halombattaHungary. The following fish species were used in the present study:

Common name	Denoted	Scientific name
1. Common carp	CC	Cyprinus carpio L.
2. Chinese carp :		
a - Bighead carp.	Bhc	Aristichthys nobilis Rich.
b - Grass carp.	Gc	Ctenopharyngodon idella Val.
c - Silver carp.	Sc	Hypophthalmichthys molitrix v l.
3. Tench	T	Tinca tinca L.

Cross-breeding of common carp, chinese carp and tench was conducted by artificial propagation technique using the dry method. Spawning was promoted by carp pituitary treatment. The female recieved the pituitary hormones in two dosage while the males in one only. Clean settled pond water (22-24°C) was used for fertilization of chinese carp eggs while in case of the common carp and tench a special solution of sodium chloride and urea (40 gm NaCl + 30 gm urea/10 liters of clean pond water) was used. The percentage of fertilization was calculated by sampling eggs (100-200 eggs) from each incubator before the early morula stage and at the end of gastrulation stage. At the end of incubation period, the living larvae were counted and the hatching rate was calculated.

RESULTS AND DISCUSSION

Tables 1 and 2 summarise the fertilization rates and hatching rates of common carp, chinese carp & tench, and their different combination crosses. The analysis of variance and Duncan's multiple range test (table 3) revealed that:

No significant differences were observed between the cross breeds of common carp females with bighead or silver carp males and its maternal species in rate of fertilization. However the cross breeding of common carp females with grass carp males was highly significant and showed a very low fertilization rate when compared with those of their pure parent species (tables 1 & 3).

In addition the cross-breeds of common carp females with bighead or grass carp males showed significant depressed hatchability in comparison with those parent species, but in case of common carp females X Silver carp males crossing, about 58.74% of the eggs were hatched, which was not significantly different (P> 0.01) from its maternal species.

Chaudhuri (1971) reported that it is easy to hybridize fishes related to each other. The diploid chromosome number (2n) of the chinese carp (Bighead, gass and Silver Carp) is 48 in homologous paris and the karyotypes of the species are almost identical (Marian and Krasznai, 1979 and 1980), whereas the chromosome number (104) of common carp is tetraploidy. Therefore the chromosome compatibility is a limiting factor for successful species hybridization. Moreover the differences in the period of eggs incubation and the high differences in the size of eggs of the parent species could be responsible for poor results.

Hybridizing Common carp females with tench males resulted in about 49% fertility, which was significantly different ($P < 0.01$) from their pure species, while the hatching rate was 46.77% (tables 1 & 2), Bakos et al (1976) mentioned that, when crossing Common carp and tench, 97% of the eggs become fertile, but after twelve hours later only 32% of the

TABLE (1)

The fertilization rates (in percent and angles) of eggs of common carp, Chinese carp, tench and their different combination crosses during the artificial incubation period*.

Males		FEMALES: Common carp	FEMALES: Bighead carp	FEMALES: Grass carp	FEMALES: Silvar carp	FEMALES: Tench	Mean x ± SE
Common carp	%	71.23	N.V.	N.V.	N.V.	N.V.	71.23
		de					B
	Angles	57.68 ± 1.29					57.68 ± 1.29
Bighead carp	%	67.82	75.73	86.96	74.78	N.C.	76.32
		e	cde	ab	cde		A
	Angles	55.53 ± 1.93	60.78 ± 2.19	69.50 ± 2.43	59.94 ± 1.32		61.97 ± 1.42
Grass carp	%	43.20	53.02	80.92	49.20	N.C.	56.58
		f	f	bcd	f		C
	Angles	41.09 ± 0.20	46.73 ± 0.76	64.62 ± 2.28	44.54 ± 0.08		51.25 ± 2.26
Silver carp	%	73.85	85.18	55.64	92.68	N.C.	76.84
		de	bc	f	a		A
	Angles	59.39 ± 1.28	67.36 ± 0.27	48.35 ± 3.08	74.88 ± 1.79		62.84 ± 1.98
Tench	%	49.00	N.C.	N.C.	N.C.	87.35	68.17
		f				ab	B
	Angles	44.43 ± 0.62				69.20 ± 0.72	55.44 ± 4.37
Mean	%	64.11	71.31	74.51	72.22	87.35	
		A	B	B	B	C	
	Angles	59.48 ± 1.35	58.58 ± 2.22	62.26 ± 2.53	61.48 ± 3.07	69.20 ± 0.72	

* Only means with different superscript letters are significantly differen: ($P < 0.01$).

N.V. : No viable embryos observed. N.C. : No crossing made.

TABLE (2)

The hatching rates (in percent and angles) of eggs of common carp, Chinese carp, tench and their different combination crosses, during the artificial incubation period*.

Males		Females: Common carp	Bighead carp	Grass carp	Silver carp	Tench	Mean $x \pm SE$
Common carp	%	67.01 cd	N.V.	N.V.	N.V.	N.V.	67.01 A
	Angles	55.00±1.08					55.00±1.08
Bighead carp	%	51.50 e	71.31 cd	64.73 cd	69.50 cd	N.C.	64.26 A
	Angles	45.83±2.10	57.85±1.98	54.05±1.46	56.63±1.65		54.72±1.52
Grass carp	%	17.73 g	45.20 ef	71.13 cd	13.77 g	N.C.	36.96 B
	Angles	24.89±0.38	42.22±0.98	57.84±2.03	21.79±0.05		42.45±3.51
Silver carp	%	58.74 de	75.37 bc	33.96 f	87.72 a	N.C.	63.95 A
	Angles	50.07±1.62	60.85±0.31	35.58±1.59	69.60±0.96		53.79±3.62
Tench	%	46.77 ef	N.C.	N.C.	N.C.	85.00 ab	65.88 A
	Angles	43.15±0.76				67.23±0.62	55.19±4.57
Mean	%	48.35 A	63.96 B	56.61 B	56.99 B	85.00 C	
	Angles	46.59±1.92	54.54±2.10	51.18±2.69	53.01±4.61	67.23±0.62	

* Only means with different superscript letters are significantly different ($P < 0.01$).

N.V. : No viable embryos observed.

N.C. : No crossing made.

eggs proved to be viable and 26% of the fertilized eggs hatched out. No explanation could be offered for this, since there is no data available in literature on the genetics of tench (Kirpichnikov, 1971).

When chinese carp species (bighead, grass and silver) or tench females were crossed with males of common carp, no viable embryos were observed and no living larvae were obtained (table 2). This might be due to physiological constraints due to incompatibility of the cytoplasm in certain species such as common carp with chromosomes of some other species (i.e. chinese carp or tench). Nikoljukin (1971) explained this phenomenan by the fact that differences of the reciprocal forms of hybrids are determined by cytoplasmic differences of the crossed species which will result in differnt interaction of the nucleus and the plasma in reciprocal crossing that will lead to some hybrid which may be viable and other which may not.

Although the chromosome number (2n) for all chinese carp species was the same (48), the hybrids of grass carp X silver carp and silver carp X grass carp exhibited significantly lowest fertilization and hatching rates when compared with those of their parents. However the hybrids of bighead carp X silver carp & silver carp X bighead carp and grass carp X bighead carp exhibited better values, for these parameters than the previous present hybrids which indicate higher genetic similarily (Tables 1, 2 and 3).

TABLE (3)

Analysis of variance of fertilization and hatching rates of eggs of common carp, Chinese carp, tench and their different combination crosses during eggs incubation period.

S.O.V.	Fertilization Rate		Hatching Rate	
	d.f.	M.S.	d.f.	M.S.
Between crosses	14	344.23**	14	603.60**
Between male crosses	4	523.41**	4	594.40**
Between female crosses	4	439.35**	4	469.00**
Error	70	21.25	62	23.80

From the previous results it is clear that all crosses showed negative heterosis values in terms of fertilization and hatching rates with exception of crosses of bighead carp X silver carp and grass carp X bighead carp which exhibited only positive heterosis values in fertilization rates (table 4). However, the results presented in this table revealed that those crosses exhibited the lowest heterosis values in fertilization rates (i.e. common carp X grass carp, grass carp X silver carp and silver carp X grass carp) as well as the lowest heterosis values in hatching rates.

Moreover the results represented in table 4 revealed negative heterotic effect in case of fertilization rate of the crossbreeds (bighead carp X grass carp but the opposite was true in case of the back crossing (grass carp X bighead carp). This could be related to sex-linked genes which may have some effect on fertilization rate in fish and the trend observed in the cross (bighead carp X silver carp) and its back cross (silver carp X bighead carp). Results in (Table 1) prove the obove conclusion.

TABLE (4)

The heterosis values of fertilization and hatching rates of eggs of 10 crosses produced by pairing gametes from common carp, Chinese carp and tench.

Parent species* ♀ x ♂	Fertilization rate (%)	Hatching rate (%)
Cc x Bhc	- 7.70	-25.53
Cc x Gc	-43.21	-74.33
Cc x Sc	- 9.88	-24.07
Cc x T	-38.20	-38.46
Bhc x Gc	-32.30	-36.53
Bhc x Sc	+ 1.16	- 5.21
Gc x Bhc	+11.02	- 9.11
Gc x Sc	-35.90	-57.24
Sc x Bhc	-11.19	-12.59
Sc x Gc	-43.32	-82.66

*
Cc : Common carp
Gc : Grass carp
T : Tench.
Bhc : Bighead carp
Sc : Silver carp

Also the results present in Tables 1 and 2 revealed an interesting point, where males of silver and bighead carp showed specific combining ability in fertilization and hatching rates when crossed and mated common carp or grass females. These results will be of good value from the commercial point of vew.

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