

Comparative performance test of six crossbred common carp lines in intensive pond culture

The main aim of this study was to make a comparative performance test among six newly produced common carp (*Cyprinus carpio*) crossbred lines. The parental strains of the crossbred lines were originated from NARIC HAKI's gene bank (pure lines) that show higher production performance (e.g. growth rate, feed conversion, disease resistance, survival etc.). The test lines were reared in pond production conditions with intensive feeding by formulated feeds. The comparison of the crossbred lines was done at the end of the second year on growth parameters, body indices and carcass yield. The results of this study can be applied in development of new common carp strains by crossbreeding or selective breeding.

In this study six common carp crossbred lines were made (two scaled and four mirror) in May 2014, as a result of different crossing combinations of six purebred common carp strains. Two years of (intensive) pond production period was planned with applying intensive feeding by formulated feed. It is the only possibility in this climatic conditions to achieve market size fish at the end of the second year.

The test among the six crossbred lines was done based on the second year's performance. Group marking was applied (cut off different fin combinations) in the experimental crossbred lines therefore; it enabled pooled rearing in a single pond design. A combined experimental design was applied, cage and pond design in the same pond. Each crossbred line was stocked in different cages with the volume of four m³ in three replicates, in total eighteen cages were applied. In one cage, twelve fish were stocked from each experimental crossbred line, in total 36 individuals from each line.

In the pond design, 100 fish were stocked from each experimental line in a 3980 m² pond with 1500 pcs/ha stocking density. Formulated common carp feed was applied to feed the experimental fish with 35% of crude protein and 4% of crude fat in 1.5% of feeding rate.

Preliminary results

Shortly after (eight days) the commencement of the trial mass mortality could be observed in the cages and in the pond also. The intensity of the mortality showed increasing tendency until the eighteenth day of the experiment, then the rate of mortality has decreased. The feeding was suspended at the tenth day of the experiment. Sample was taken from the affected fish and sent to pathological examination. It showed only a slight secondary infection by parasites, which did not explain the mass mortality. Water quality monitoring was done weekly from both, the influent and effluent water and it showed remarkable decay in quality parameters especially in the toxic nitrogen forms. The causative of the poor water quality was an external uncontrollable effect. The experiment was terminated at the 24th day due to the high mortality. However, there were substantial differences in the survival rate among the crossbred lines. While the survival rate of the experimental group II. was 38.89%, until then the group III. showed 100% survival in the cages, furthermore the weight gain was also the highest in this crossbred line. Among the mirror lines only the experimental group III. showed survival over 50% (100%). In the scaled lines the group IV. showed good survival (97.22%), while the other scaled line (group I.) had survival of 86.06%.

The results of the pond experiment was similar that of the cages, it was even larger differences in the survival.

The second trial

The pond experiment was repeated with those three lines (I, III and IV) that showed good survival rate. The applied stocking was 70 fish from each groups to a pond with 1857 m² therefore, the stocking density was 1130 pcs/ha. The same feed was applied as before, only the feeding rate was varying between 0.5-4% according to the water temperature, the appetite of the fish and the zooplankton availability. Pond manuring was done four times during the experiment with the dosage of 1 ton/ha. Zooplankton sample was taken biweekly (from 100 L of pond water) to be able to monitor the natural food availability. Test fishing was applied monthly to be able to assess the condition, health status and growth of the fish. The experiment was lasted for five months (June to November). After the termination of the experiment 20 fish were randomly chosen from each experimental group for the examination of body indices and carcass yield.



The harvested common carps on the sorting table

Results of the trials

At the end of the trial it was determined that the test fish grown according to the planned intensive two years production period. It was also confirmed by the results of the test fishing during the growth period. Nevertheless, the natural food availability was moderate despite of the frequent pond manuring. The density of zooplankton was 15 ml/m³ at the beginning of the experiment then it showed decreasing tendency over time. By the end of July, the natural food availability was unmeasurably low. By September, the zooplankton availability increased again to moderate level (15 ml/m³) then it also decayed to unmeasurably low. Since the measurements showed very low natural food availability therefore, higher feeding rate was applied (4%) during the summer (July and August).

It can be stated by summarizing the first cage and pond experiments that the experimental group III. showed clearly outstanding results in growth and survival as well. While in the cage experiment it gave 100% survival, until then in the first pond experiment the survival of this

group was 98%. Even in the second pond experiment the survival of group III. was still over 90%. In body weight gain the same (group III.) experimental crossbred line showed the best results in comparison to the other groups in all experiments. The first test results (cage and pond) showed that group III. showed the best growth and survival among the mirror groups in poor water quality conditions, thus the mentioned crossbred line likely more tolerant to the negatively changing environmental conditions (higher environmental stress tolerance or better adaptation ability to unfavorable environmental conditions).

Since the parental strains of group III. contributed to the production of another crossbred groups that were also involved in this test, but those halfsib crossbred lines did not showed outstanding performance therefore, it is difficult to assess which strain carry those genes that responsible for this outstanding performance in that poor environmental conditions. Thus, it is suggested to test both parental pure strains of group III. (crossbred line) and both ways crosses of those strains in controlled condition with different ammonia levels.

Since the group I. is a purebred strain and the maternal strain of group IV. is the same as group I. therefore, the paternal strain of group IV. has favorable genetic effect on the crossbred.

The other two scaly experimental groups (group I. and IV.) better tolerated the less optimal water quality conditions than the average mirror groups. Comparing the growth and survival of the two groups it can be stated that the experimental group IV. shows better performance.

After slaughtering the 20 fish from each experimental group body-size indices and carcass yield were measured and calculated. **Table 3.** shows the results of the slaughter value test.

Table 3. Results of the slaughter value examination by the average values of the groups.

Slaughter value test				
Denomination	Unit	Experimental crossbred lines		
		I. (Scaled)	III. (Mirror)	IV. (Scaled)
Total length	cm	37,60	42,70	39,58
Trunk length	cm	30,65	35,00	32,68
Head length	cm	9,42	9,86	9,53
Body height	cm	14,06	14,34	14,62
Body width	cm	7,31	7,52	7,55
Live body mass	g	1305,00	1613,80	1449,50
Abdominal fat weight	g	11,05	7,90	10,50
Left filet weight	g	286,00	399,75	336,75
Head weight	g	136,70	159,90	142,15
Gill weight	g	64,45	74,50	66,95
Viscera weight	g	159,55	173,20	170,00
Gonadal weight	g	20,05	37,85	24,80
Carcass weight	g	776,30	1072,80	888,00

The results of the slaughter value examination clearly represents the differences in body shape among the different experimental crossbred lines. The group I. and group IV. have rounded body shape with higher body height and shorter trunk length values, while the group III. has flatter more elongated body shape. Surprisingly the group III. with the highest live body mass showed the least average abdominal fat deposition (7.9 g). The group III. showed also the highest average left filet weight (399.75 g), which comes from the highest body mass however, proportionally still this group shows the best filet yield. The average head and gill weight were the highest at the group III. even in proportional consideration. The average viscera weight was only slightly higher for group III. (173.2 g) compared to group I. and group IV. 159.55 g and 170.0 g respectively, hence the visceral loss is the lowest at group III. In general, the gonads were underdeveloped especially the ovary in all group, mainly because of the age of the experimental fish (two years). The sex ratio was 48 : 52% female-male

respectively. In the average carcass weight the group III. showed by the orders of magnitude higher value (1072.8 g) than the other groups 776.3 g and 888.0 g group I. and IV. respectively.

Summarizing the slaughtering test results, it can be stated that the experimental group III. showed the most preferable slaughter trait values, hence the further test and breeding of this experimental crossbred line is recommended.

Nowadays, the environmental conditions are getting more instable and unusual (climate change) as well as the aquaculture production is tending to be more intensive hence, it will be more difficult to constantly provide the optimal water quality conditions in an intensive pond culture. Thus, it is important to recognize the utility of those fish strains that have better adaptation ability and utilize them in breeding to select for environmental stress tolerance. The environmental stress tolerance is a valuable trait and its use in the breeding will be more essential in the future.