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THE EVALUATION OF THE FREQUENCY OF THE THREE FENOTYPES OF CARP (CYPRINUS CARPIO CARPIO, LINNE 1758)

Përmbledhje: Studimi i gjenofondeve të llojeve të kultivuara është ndoshta argumenti më pak i përpunuar në akuakulturë. Arsyeja kryesore është se akuakultura duke përfshirë në kuadrin e saj një numër shumë më të madh llojesh iktike krahasimisht me zootekninë tradicionale, ka qenë më shumë e prirë nga produktet „natyrore” sesa nga preokupimi për t’i „qeverisur” potencialet gjenetike të tyre në drejtim të një stoku që premtion nivele më të larta e më të qëndrueshme të prodhimit. Qëllimi kryesor i këtij studimi ka qenë njohja e strukturës gjenetike të popullatave të kultivuara të krapit, kryesisht bazuar në studimin e frekuencës së gjenotipeve të mbulesës luspoze si dhe i mundësisë për shfrytëzimin e disa indekseve të eksteriorit në punën racore me këtë lloj.

Fjalë kyçe: *krapit, gjenotipe të kultivuara*

Abstract: The study of the different cultivated genotypes may be is the less processed argument in aquaculture. The main reason is that aquaculture, including in its framework a very big number of ictic types compared to the traditional zoo technique, has been more subjected towards ‘natural’ products than towards the preoccupation to ‘govern’ their genetic potentials toward a stock that promises higher and more stable levels of production. The main scope of this study has been the knowing of the genetic structure of carp’s cultivated populations, mainly based in the study of the frequency of the genotypes of scaly coat and of the possibility to utilize some exterior indexes with this type.

Key words: *carp, cultivated genotypes*

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INTRODUCTION

Almost 90% of the whole racial work that has been done in aquaculture has had as an object the carp (*Cyprinus carpio*) (Spaho *et al.*, 1998). The results have been different and the fact that has more interest to be stressed is that the morphological options of this fish, which are a consequence of the execution of the racial programs (Basavaraju, 2007) can obviously be distinguished by the wild form, manifesting some features that can be considered as „economically adequate” although the forms that possess them are sometimes introduced as „ecologically inadequate” in some categories of natural environments (Cheng *et al.*, 2001). For a long time the racial improvement of the carp has been conducted based on the classical methods of massive selection. Although the carp, like fishes in general are distinguished for minor values of the heritability of the quantitative features, high fertility and variability relatively stressed of the features in general, creates enough good opportunities for pre-selection (Vandeputte, 2003). In the semi-intensive technologies of cultivation of cyprinides where the carp composes the first or the second culture (Tanck *et al.*, 2000) it is very important to define the race of the carp that must be integrated in fishing. As we are going to show in this work not rarely the character of the environment and the level of intensification tell us not only the species composition of the policulture but also the races we can cultivate. The work that we are going to introduce has as its object some of the races of the carp present in our systems of cultivation. We believe that the consellings that we propose will be a contribution in the improvement of the technologies of the cultivation of this species.

MATERIALS AND METHODS

The evaluation of the three phenotypes in the cultivated populations of the carp

The study has been concentrated in the evaluation of the following features: the method of the distribution of the scales in the two sides of the body, the number and the size of the scales, the number of the scales in the side line, the number of the strong rays and the soft ones in the spinal fin, and that of the chest and the abdomen, the regularity of the positioning of the fins in the case of the fin race (harmonious straight placement, order of fins placed in an irregular way, totally irregular placement). The results of the analysis have been registered separately for each of the phenotypical options, within the same population. The number of individuals evaluated for each race has always been bigger than 30. For the realization of this study we have worked mainly with the populations of the improved Hungarian carp of the races (*morpha*) „scaly” (genotypes SSnn dhe Ssnn) and „mirror” (genotype SsNn). These races are distinguished for the small head and the high back (Moav & Wohlfarth, 1974). In the aspect of the cultivation they are races destined to be cultivated mainly in the systems of the intensive type since they are gluttonous enough.

The analysis have been conducted in populations of the ages 0 + (from the rasats to the age of 11 months) and 1 + (12 to 23 months). In some analysis we have used individuals of old age. The biological studies have been concentrated in the analy-

sis of some morphometric indicators. Their scheme has gravimetric indicators and measurable indicators. The measurements made are: the general weight (W_g), the zoological or total length (L_{cm}), the industrial or standard length (l cm), the maximal height (H_{cm}), the length of the head (*cf.* cm), the perimeter to the maximal height (O_{cm}). In order to realize the measurements, a metallic meter has been used. The maximal height has been measured with a caliber. The fishing has been done with a Sartorius type of electronic scale, with accuracy 0.01 g. The analysis has been done directly in the premises of the cultivation systems, always operating with alive material.

RESULTS AND DISCUSSIONS

*The results of the evaluation of the three phenotypes of the feature „scaly coverage” in a cultivated population of the carp (*Cyprinus carpio*).*

We have done the evaluation of the phenotype of the carp, according to the feature „scaly coverage” starting from individuals of one-month age (veracs). Even before this age exists the opportunity of the definitions of the phenotypical options of the scaly coverage but the error frequency is high because of the fact that the scales are very small. This evaluation has been done in fixed dates every month. The samplings have been taken in the same pond, in a mixed population, thus that has the three „races”, for a period of 12 months. The data of the analysis of the samplings are given in the Table 1.

In the 12 samplings done the phenotype that has been encountered with a higher percentage was „the wild form” or „the scaly carp”. Most of the data of the literature that treats problems of genetics of this type considers the scaly form as an ancestral phenotype. The mutations that have occurred in a second time in the genes that respond to the character of the scaly coverage led to the appearance of the alternative phenotypes of this feature.

The average of the values of the frequency of the phenotype „carp with spread scales” results to be something bigger towards the average of the average of the frequency of the phenotype „mirror carp” (respectively 8.9% towards 7.7%).

By introducing these figures we need to mention the fact that we are working with a cultivated population, successor of a partly controlled fertility. We make this remark because the data of the fishings in the free waters (lakes, rivers, reservoirs), where opportunities for natural reproduction of the carp exist, have shown that the option „carp with spread scales” is seen with a lower frequency compared to the „mirror” carp.

There is a great possibility that in the nature to be formed „elementary populations” of the carp composed by monotypical individuals or with a domination of individuals of one race (Cavalcanti *et al.*, 1999). The individuals of the „local populations”, go away in a distance enough limited by the center of their specific habitat (Kohlmann & Kersten, 1999).

The isolated populations behave as „closed” in the aspect of reproduction. As a consequence the microevolutionary process within these groupings could take to a dominance of one of the phenotypes. The domination of each of the three known pheno-

types from each other depends on the ability for survival, in the conditions of equal chances that the same habitat offers. The full absence or the low frequency of the intermediate forms, in the natural environments, is an expression of „spatial barriers” for the hybridization of the distal races. In this case there is no connection with the authentic geograofical isolation.

If we examine the dynamics of the calculated values for the frequency of the three fenotypes we notice that during the transition from the phase of the young ones (veracs) at the age of 1-year, the frequency of the scaly fenotype in the population increases at the same time that the frequency of the individuals of the two fenotypes decreases.

The data of the statistical analysis showed very minor changes in the decrease of the values of the frequency of the fenotypes „spread scales” and „mirror” with the increase of the age of the carp. The selective mortality, caused by the differences in the indicators of the survival among individuals that posses the analysed fenotypes must have been the main reason of the changes in the dynamics of the frequency of the three fenotypes, during the increase of the age. In these conditions in the ponds the „scaly” fenotype represents a higher survival compared to the other fenotypes.

Table 1. Frequency (%) of the three fenotypes of the scaly coverage in the cultivated carp population

Month	No. of the sampled individuals	Typical scales carp (Genot. SSnn, Ssnn)		Spread scales carp (Genot. ssn)		Mirror carp (Genot. SsNn)	
		Pieces	%	Pieces	%	Pieces	%
1	200	139	69.5	31	15.5	30	15.0
2	230	161	70.0	37	16.1	32	13.9
3	195	140	71.8	31	15.9	24	12.3
4	210	164	78.2	23	10.9	23	10.9
5	223	185	83.0	20	8.9	18	8.1
6	213	183	86.0	16	7.5	14	6.5
7	207	180	87.0	15	7.2	12	5.8
8	215	191	88.8	12	5.6	12	5.6
9	200	180	90.0	11	5.5	9	4.5
10	209	190	91.0	11	5.2	8	3.8
11	211	194	92.0	10	4.7	7	3.3
12	207	193	93.3	8	3.8	6	2.9

In the case of the use of the expression „environmental condition” we have in mind a complexity of factors which modifies the specific characteristics of the increase of the individuals in the populations of this kind. But in fact in our study, although we have to do with a plant of directed raise, the scale of antropogenic interventions in the modelling of the ecosystem, at least for the ponds of the rasats, has not been considerable. The pond where the population was located from which we took

the samplings, because the sole intensifying intervention was organic fertilization of the water, resembles a lot a natural ecosystem where the fish reproduction is almost equal to natural production.

In order to support our conclusions in the pond of the proof we have done a monitoring of some environmental factors, biotic and abiotic, during the whole period that the samplings were done. Some quantitative evaluations for the analysed parameters are introduced below (Table 2).

Table 2. Some data of the analysis of the environmental parameters in the ecosystem of the pond where the samplings were done

The analysed parameter	Unit of measurement	Period of the proof			
		March-May	June-August	Sept-November	Dec-Feb
Oxygen	mg/l	3.2–5.8	1.9–3.6	2.7–4.9	3.2–3.9
CO ₂	mg/l	12.8–24.3	19.2–26.1	15.0–20.1	11.2–16.3
BOD	mgO ₂ /l	20–23	27–34	21–25	14–16
NH ₄ ⁺	mg/l	1.02	1.46	1.12	0.89
Biomass:					
-zooplankton	g/m ³	19–42	19–42	21–36	7–18
-zoobentos	g/m ²	7–12	4–9	6–8	2–5

For the study of the differences in the indicator of survival, the placement of the three races of the carp in the same environmental conditions has been a positive fact, where the intervention of the cultivator on the ecosystem was not inconsiderable. The figures demonstrated in Table 2 show that we have to do with a cultivation system that approaches fully to the extensive form. In such conditions the „scaly” form demonstrates to be more resistant. The losses of this form, caused by the natural mortality, are smaller compared to the other two forms.

CONCLUSIONS

The analysis of the samplings done in the population of the cultivated carp showed that the phenotype that was encountered with a higher percentage was „the wild form” or „the scaly carp”.

With the growing of the age of the individuals, especially in the phase of the verac in the rasats (0 +) the frequency of the phenotype „scaly” in the population grows during the time that the frequency of the individuals of the phenotype „mirror carp” and „carp with spread scales” decreases.

The differentiated mortality, caused by the changes in the survival indicators, among individuals that possess the analysed phenotypes, must have been the main reason of the variability in the dynamics of the frequency of the three phenotypes, during the growing of the age. As results show, in the conditions of the cultivation with the half-intensive regime, the phenotype „scaly carp” presents higher survival compared to the other two phenotypes.

The presence of the gene „N” in the genotype of carp has caused the fall of the values of the rate of growth. The differences of the indicators of survival among the three species of carp, and the change of the intensity of growth becomes more visible in the absence of the intensifying interventions, thus in the environments where no food is used and where the performance of environmental factors is dictated by the nature and its laws.

Carp farmers can have the planned results if the „mirror” and „spread scales” carp is cultivated in systems of the semi-intensive farming, where food is systematically given, especially in periods when natural food base has a weak growth, or in systems that are completely intensive. These forms of the carp are grown bad and have poor survival indicators if cultivated in extensive systems.

„Scaly” carp which lacks dominant „N”, appears resistant to extreme environmental conditions, which also appears from the highest rhythm growth, and can be cultivated successfully not only in the semi-intensive systems but also in intensive entirely systems and also in basins where human intervention lacks (lakes, rivers and tanks). As such this breed of carp is fully appropriate to be included in programs of reproductions. In the latter case should be taken into account the phenomenon of „genetic pollution”. It would be reasonable that in the reproduction programs be included only „scaly” carp of the local ecotypes so as to avoid the mentioned phenomenon.

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