Estimating The Productive Parameters of Common Carp Fish Genetically Improved by Selection

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Received:13/09/2023 Accepted: 15/10/2023

Abstract

This study was conducted in a fishery in the Sheikh Saeed area in the countryside of Aleppo on carp fish to improve some productive traits and estimate their genetic parameters through selection for the best individuals that possess the best productive characteristics. In this experiment (50 fish) were used. Productivity measurements were taken for some meat production traits (weight live, total length, body depth, head length) from the age of marketing 6-7 months until the age of sexual maturity 1.5-1 years. This study was conducted in 2021 to 2023. The results indicated that there were no significant differences between all individuals for all traits, but there were some significant differences between each of the offspring resulting from selection and the clan for the traits measured by most months.

Keywords: common carp, selection, Genetic parameters, Total weight, Total length, Body depth, Head length.

Introduction:

Cyprinus Carpio fish is one of the oldest and the most important domesticated type for aquaculture which has a big trade value as a resource for a human's food, It was entered a different regions of world and the secondary global production is more than 22% in 2022 and it was about 14% from all aquaculture in pure rivers water.Cyprinus Carpio production have increased with world average 9.5% between 1985-2002 (FAO, 2012).

One of the main reasons for success achieved by aquaculture is the diversity of currently used species in culture (more than 230 species). However culturing many of species that currently started depending on fry or young fish or on wild broodstock. (Eibsh Mamdouh.., 1987).

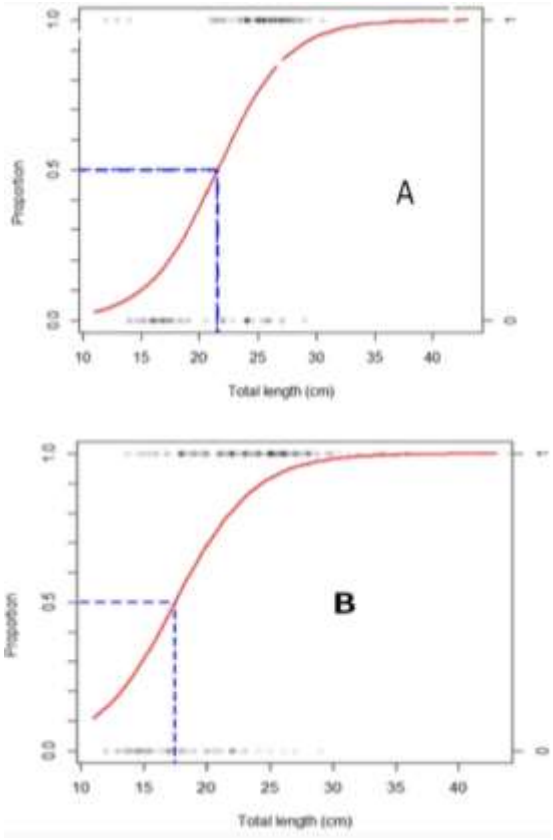
The current methods of animal selection are closely related to the recent achievements in the field of quantitative genetics and population, and the selection of fish depends on the planned use of the genetic diversity inherent in all organisms (Kirpichnikov…, 1966).

The study showed that the successful selection of mothers (male and female) used in hatching is the first step in a correct direction to get a high production in a fish culture (Mouslli..., 2016).

The length at first sexual maturity: Size at maturity is the size in which 50% of the fish mature for the first time (Tessema..,2020). This study was conducted in Hayek Lake between January and December 2018, and aimed to determine growth, condition, sex ratio and fertility and height at first sexual maturity.

Height in cm (TW) and total weight (TL) were measured for each individual, and their relationship was determined using the power function. The length at first maturity for both males and females was using a logistic regression model. The Hatching season was determined from the frequency of mature gonads. The relationship between height and weight for males, which indicates a negative measured

growth, TW= 0.018 for females, that showed there was a significant deviation between the numbers of males and females. P>0.05. The length was for females 21.5 cm and for males 17.5 cm, at the first sexual maturity, as females mature in larger size than males. (Tessema,..2020).



Height at first sexual maturity for females (a) and males (b) (Tessema,..2020)

The body length traits (BL) and body depth traits (BW) for fish are important parameters of great importance in breeding, feeding and classification (YU….,2021).

A typical fish measuring process involves weighing the fish using a digital scale, measuring its body lengths using a ruler (Saleh et al…, 2023). And assessing specific morphological traits including the distance from the tip of the mouth to the posterior midpoint of the caudal fin or the depth of the body from the posterior base of the fin dorsal to anterior part of the anal fin (Jerry et al…, 1998).

Aim of study:

- Selection of the best individuals from the base clan group to be the group of elected individuals to be intermarried and to obtain a group of offspring and generations characterized by high production qualities.
- Estimating productivity parameters (total weight, total length, head length, body depth) for the study groups.

Materials and Methods:

Study was conducted in a fishery in Sheikh Saeed area on Carp fish, and the ponds have a base of cement and hard soil with a depth of 3 meters, and the water in it has a volume of 500 m^3, and it is renewed on a daily basis to provide oxygen dissolved in the water in sufficient quantities, as the water temperature was between 21-27 °C, as its need for oxygen ranged between 0.3-0.5 mg / liter of oxygen and a PH between 6.5-9.

Fish feeding in the early stages of fish life, it was meat and well ground liver that formed fingerlings in the early ages to eat and adopt it as a food source to build its body. With age, bread, bran and bulgur were introduced, in addition to alfalfa and azolla plants, poultry waste is introduced on the tenth day

as a main food to reach a high weight in a short period, and it continues to feed on the waste until the age of marketing 6-7 months.

Study was conducted during the period 2021-2023 for three groups of carp:

* Group 1: Basal population group.
* Group 2: Group of selected individuals (parents: they are the best selected individuals from the basal clan).
* Group 3: Children's group (children of the elected individuals).

Individuals selection consisted of males and females, where the ratio was 2:1, where each female needs two males, as they were elected at the marketing age of 7 months, as her body was free from bruises, wounds, and parasites, and her genitals were free from deformities, and the male was distinguished from the female By observing the reproductive system of the fish, as the female carp has a relatively wide genital opening with a red nipple, while the male's genital opening is white, small, prominent in the shape of a letter V (Warda.., 2021). Measurements were taken from the age of marketing 6-7 months until the age of Sexual maturity 1.5 years.

Measurements of productivity parameters were estimated for all fish of the three studied groups.

Studied parameters:

1- **Total Length (TL):** Measured from the front of the head with the mouth closed to the end of the tail.
2- **Total weight (WL):** It is measured by the weight of the whole fish in grams.
3- **Body Depth (BD):** It is the vertical distance at the widest area of the body measured from edge to edge in that area.
4- **Head length (HL):** It is measured from the front of the head to the end of the gill cover, or it is measured from the front edge of the upper lip (snout) to the farthest point from the gill cover.

Statistical analysis:

The experiment was designed using a Completely Randomized Design (CRD) method, and the statistical analysis of the data of this study was done using the SPSS program, mediated by the computer, and the Office-Excel (2016) program was used to enter the data into the computer.

The significance of the differences between the averages was tested using the least significant difference test (LSD) at a significant level of 0.05%, and the averages, standard deviation, and coefficient of difference were calculated for the studied traits.

Results and discussion:

First: Total weight measurement:

Table (1) shows weight measurements of each of individuals that were selected to be mated, the basal population from which the best individuals were selected, and the offspring obtained as a result of the mating of the selected individuals, after securing the best environmental conditions.

Table (1): the total weights for each of the (population, parents and offspring).

Live body traits weight							
Age (months)	**offspring**		**Selected individuals (parents)**		**Basal Clan**		**significant**
	C.V%	X± Sd	C.V%	X± Sd	C.V %	X± Sd	
6	17600	980±148.32	16936	1117±145.5	20000	900±158.11	*
7	9664	1154±109.9	17856	1182±149.4	7136	1028±94.44	*
8	2584	1204±56.83	3080	1320±62.05	776	1168±31.14	Ns
9	3344	1336±64.65	5216	1452±80.75	856	1312±32.71	Ns
10	2440	1510±55.22	3016	1642±61.40	6184	1454±87.92	Ns
11	8264	1646±101.6	11784	1854±121.3	2344	1664±54.12	Ns
12	4096	1902±71.55	21360	1910±163.4	1744	1854±46.69	*

13	21296	2318±163.1	68536	2282±292.6	20000	2200±158.1	*
14	8504	2564±103.1	24424	2634±174.7	3056	2502±61.80	*
15	10576	2838±114.9	13740	2790±414.4	4544	2806±75.36	*

Ns = Non-significant; *=significant at (p<0.05**)**

The first table shows the measurement of average weight of each of basal clan, selected individuals, and offspring resulting from the mating of the parents' generation (population, parents, offspring), where the highest average weights of the selected individuals were, as it outperformed both the basal clan and offspring in most months, and that the differences were significant in the months 12, 13, 14, and 15, the age of sexual maturity, were significant among all individuals, while the differences were in the months 8, 9, 10, and 11, differences were non-significant among all individuals, with significant differences between the basal clan with offspring resulting from the selection of the best individuals. As for the 6th and 7th months, the two months are the age of marketing, the differences were significant between the offspring and clan. As for the individuals who were selected the differences between it and basal clan from which it was selected were non-significant, and also because the individuals that possess the best morphological characteristics and the highest weight were selected to be mated and obtain generation with the best specifications.

The average weight of basal clan in first months was around 1-1.5, while the resulting offspring outperformed the basal clan in weight during first months 7-8-9, and it approached the weight of the fathers in the months 9-10-11-12-13-14-15, where the weight were ranged between 1.3 kg -2.8 kg at the age of sexual maturity.

Where the selection helped to obtain a generation that has high weight and encourages the selection to obtain a generation with high weight.

Second: Total length measurement:

Table (2) shows length measurements of each individuals that were selected to be mated, the basal population from which the best individuals were selected, and the offspring obtained as a result of the mating of the selected individuals, after securing the best environmental conditions.

Table (2) : the length measurements for of the (population, parents and offspring).

Total Length Trait							
Age (months)	Offspring		Selected Individuals (Parents)		Basal Clan		Significant (P)
	C.V%	X± Sd	C.V%	X± Sd	C.V %	X± Sd	
6	0.24	10.6±0.55	0.282	9.86±0.59	0.194	9.64±0.49	Ns
7	0.058	11.86±0.27	0.262	11.24±0.57	0.118	10.96±0.38	Ns
8	0.089	12.68±0.33	0.065	12.38±0.28	0.046	11.84±0.24	Ns
9	0.065	13.82±0.29	0.126	13.44±0.39	0.058	12.84±0.27	Ns
10	0.046	14.74±0.24	0.058	14.34±0.27	0.157	14.22±0.44	*
11	0.06	15.6±0.27	0.102	15.36±0.35	0.01	15.26±0.11	*
12	0.17	16.64±0.46	0.085	16.78±0.32	0.053	16.52±0.25	*
13	0.082	17.74±0.32	0.138	17.54±0.41	0.045	17.28±0.23	*
14	0.329	19.21±0.64	0.314	19.34±0.62	0.221	18.88±0.52	*
15	0.185	22.12±0.48	0.298	21.64±0.61	0.122	21.26±0.39	*

Ns = Non-significant; *=significant at (p<0.05)

Third: Body depth measurement:

Table(3) shows length measurements of each individuals that were selected to be mated, basal population from which best individuals were selected, and offspring that were obtained as a result of the mating of the selected individuals, after securing the best environmental conditions.

Table (3) shows body depth measurements for of the (population, parents and offspring).

Body Depth Trait							
Age (months) X± Sd	Offspring		Selected individuals (Parents)		Basal Clan		Siginficant
	C.V %	X± Sd	C.V%	X± Sd	C.V %	X± Sd	
4.65±0.24	0.025	4.18±0.17	0.046	4.65±0.24	0.025	4.18±0.17	**Ns**
5.22±0.29	0.013	4.54±0.11	0.065	5.22±0.29	0.013	4.54±0.11	**Ns**
5.76±0.23	0.01	4.92±0.13	0.042	5.76±0.23	0.01	4.92±0.13	**Ns**
6.02±0.16	0.013	5.18±0.13	0.021	6.02±0.16	0.013	5.18±0.13	**Ns**
6.14±0.11	0.017	5.52±0.14	0.01	6.14±0.11	0.017	5.52±0.14	**Ns**
6.52±0.26	0.045	6.32±0.23	0.053	6.52±0.26	0.045	6.32±0.23	*
7.28±0.19	0.02	6.9±0.15	0.029	7.28±0.19	0.02	6.9±0.15	**Ns**
7.88±0.24	0.058	7.36±0.27	0.045	7.88±0.24	0.058	7.36±0.27	**Ns**
8.62±0.13	0.01	7.96±0.11	0.013	8.62±0.13	0.01	7.96±0.11	**Ns**
9±0.25	0.065	8.32±0.28	0.052	9±0.25	0.065	8.32±0.28	**Ns**

Ns = Non-significant; *=significant at ($p<0.05$)

The third table shows the average body depth measurement for each basal clan, selected individuals, and offspring resulting from parental generation mating (Population, parents, offspring), and shows the vertical distance in the widest region of body and was measured from edge to edge in that region. Where the highest was at the age of 6 months, the marketing age among offspring resulting from selection, while in months 7-8-9 the selected individuals were the highest compared to basal clan and individuals resulting from selection, and yet offspring were close to selected individuals in the 10-months 11-12-13. The offspring also excelled well in 14-15th month at age of sexual maturity over basal clan, and it was close to the selected individuals, while the differences were non-significant among all individuals in all months except for the 11th month, where the differences were significant. While the differences were significant between offspring and the best selected individuals in each of 6,12,13,15 months, and were significant between clan and offspring in 6,7,12,13,14,15 months. the average body depth of the basal clan in all of them was 4.18-8.32 cm, while offspring outperformed it in all months from the marketing age until age of sexual maturity, as it ranged between 4.28-8.62 cm. It Shows a depth trait that expresses the hoarding of meat. This is due to its high accumulation of meat, and in this research, the values showed positive extent of selection, as it helped to obtain a generation that has a high and good productivity specifications in terms of the most important productive traits.

Fourth: Head Length measurement:

Table (4) shows head length measurements of each of individuals that were selected to be mated, basal population from which the best individuals were selected, and the offspring obtained as a result of the mating of the selected individuals, after securing the best environmental conditions.

Table (4) shows measurement of head length for of the (population, parents and offspring).

Head Length Trait							
Age (months)	Offspring		Selected Individuals (Parents)		Basal Clan		Siginficant (P)
	C.V%	X± Sd	C.V%	X± Sd	C.V %	X± Sd	
6	0.04	1.9±0.22	0.034	2.4±0.21	0.053	1.78±0.25	**Ns**
7	0.029	2.42±0.19	0.02	2.5±0.16	0.029	2.22±0.19	**Ns**
8	0.02	3±0.15	0.02	3.4±0.16	0.02	2.8±0.15	**Ns**

9	0.02	3.5±0.15	0.02	3.5±0.16	0.02	3.3±0.15	**Ns**
10	0.017	3.98±0.14	0.02	4.4±0.16	0.02	3.8±0.15	**Ns**
11	0.017	4.38±0.14	0.02	4.4±0.16	0.028	4.2±0.18	**Ns**
12	0.013	4.88±0.13	0.02	5.2±0.16	0.021	4.18±0.16	**Ns**
13	0.02	5.2±0.15	0.01	5.3±0.11	0.034	4.74±0.20	**Ns**
14	0.058	5.36±0.27	0.005	5.9±0.08	0.017	5.18±0.14	**Ns**
15	0.02	5.8±015	0.01	6.2±0.11	0.01	5.54±0.11	*****

Ns = Non-significant; *=significant at ($p<0.05$)

The fourth table shows measurement of average head length for each of basal clan, selected individuals, and offspring resulting from the mating of parents' generation (Population, parents, offspring), measured from front of head to end of gill cover, or measured from front edge of upper lip (snout) to the furthest point from gill cover and an increase in length of head is an undesirable characteristic when marketing, and the following results show that head length at month of marketing was measured at about 1.78 for offspring, and it was less compared to the selected individuals, while it was higher than the average head length of basal clan at marketing. As for months 8-9-10, the average head length of offspring was close to basal clan and less than that of selected individuals, while in the rest of months 11-12-13-14-15, the head length of offspring was slightly close to that of selected individuals. The head from month to month is increasing, while the differences were non-significant among all individuals in all months except month 15, where the differences were significant, while the differences were significant between children and clan in the months 14, 11, 10, 9, and 7, and the differences were significant between offspring and the best individuals In months 12,11,9,8.

The average head length of basal clan ranged between 1.78-5.54, while head length increased in offspring resulting from selection. An increase in length of head is considered a negative characteristic and affects productivity. As mentioned previously, it is an undesirable characteristic. Therefore, during selection, it is preferable to direct selection to increase the weight and reduce the length of the head.

The total parameters (weight, total length, body depth, head length) that were measured indicate the possibility of significantly improving the performance of important characteristics related to fish productivity and upcoming new technology (selection), which depends on selecting the best individuals that has the best productive morphological characteristics. It is possible to select for more than one trait at a time, which increases the response to selection and speeds up obtaining improved strains that contain the best desirable traits, which means obtaining the desired goals of selection in terms of growth, disease resistance, cold and heat tolerance, carcass formation and feeding efficiency. ...and other qualities in a shorter time.

Conclusions:

- Continuous selection in the crop each year leads to better growth of fish to be parents of the next generation to give fish with productive and formal specifications with a small head, high net body, thick back, and resistance to diseases and unfavorable weather conditions.
- Directing the selection to be direct to increase the most important productive characteristics (total weight, total length, body depth) and the lack of head length because it is considered an undesirable characteristic for marketing.

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تقدير المؤشرات الإنتاجية لأسماك الكارب الشائع المحسنة ورثياً بالانتخاب

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تاريخ الاستلام:13 /2023/09 تاريخ القبول: 2023/10/15

الملخص

أجريت هذه الدراسة بمسمكة بمنطقة الشيخ سعيد في ريف حلب على سمك الكارب لتحسين بعض الصفات الإنتاجية وذلك من خلال الانتخاب لأفضل الأفراد التي تمتلك أفضل المواصفات الإنتاجية، استخدم في هذه التجربة (50 سمكة) تم أخذ القياسات الإنتاجية لبعض صفات إنتاج اللحم (الوزن، الطول الكلي، عمق الجسم، طول الرأس) من عمر التسويق 6–7 شهر حتى عمر النضج الجنسي 1.5–1سنة لكل من العشيرة القاعدية والأفراد المنتخبة والأبناء الناتجة من تزاوج الأفراد المنتخبة أجريت هذه الدراسة في 2021حتى2023. وأشارت النتائج إلى وجود عدم وجود أي فروق معنوية بين جميع الأفراد لكل الصفات ولكن وجدت بعض الفروق المعنوية بين كل من الأبناء الناتجة عن الانتخاب والعشيرة بالصفات المقاسة بأغلب الشهور.

الكلمات المفتاحية: الكارب الشائع، الانتخاب، الصفات الإنتاجية، الوزن، الطول الكلي، عمق الجسم، طول الرأس.