

Evaluation of the relative growth performance of three varieties of the European common carp, *Cyprinus carpio*, in Transkei

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Abstract

A comparison was made of the regular growth rate of three varieties of the European common carp, *Cyprinus carpio* viz. the Aischgrund, the Israeli Dor 70 and the Dor 70 x Aischgrund crossbreed varieties, using a multiple nursing method. The results showed the Aischgrund x Dor 70 crossbreed to be superior in growth where pig, cattle and chicken manure only were used as nutrients in fish ponds. When pelleted fish feed was added to the various manures, the crossbreed variety improved its relative growth performance even further. Experience showed the crossbreed to be the most docile and domesticated of all three varieties, being first able to manipulate mechanical demand feeders. The Dor 70 variety showed the second best growth performance, followed by the Aischgrund. The crossbreed appeared to be more vulnerable to predation by fish eating birds, with the Aischgrund being best able to avoid predators.

Introduction

The first experimental studies on the genetics of growth rate of the European common carp in Israel commenced in 1959 (Wohlfarth *et al.*, 1961; Moav and Wohlfarth, 1973). The major objectives of these research workers were to produce superior growing carp breeding stock for the local fish farmers and to obtain a better understanding of the role of genetics in the actual inherent growth potential of a specific variety of the common carp.

To achieve these aims, a model was designed by Wohlfarth *et al.*, (1961) to ascertain and to explain the occurrence of a large phenotypic variance under high fish density conditions which developed during the growth, from an initially small difference in size within the original population of the fish, to a considerable difference as a result of intrapopulation competition. To enable these authors to test such a phenomenon, Moav and Wohlfarth (1966) designed a so-called multiple nursing method. This allows for the correction of differences in the initial mass of different size groups of a population of a specific race of carp in order to evaluate the inherent growth potential of that particular race when this is tested under the same environmental conditions. The procedures originally designed by Wohlfarth *et al.*, (1961) were further refined by Moav *et al.*, (1975) to enable comparison between various races and crossbreeds of the common carp.

To compensate for the bias introduced by the mass gains of larger fish as against those of smaller fish within the same population, Wohlfarth and Moav (1972) used the following transformation of mass gains formula:

$$Y = Y^1 - b (\bar{x}_1 - \bar{x}_2)$$

where

Y = corrected mass gain

Y¹ = observed mass gain

b = coefficient of the linear regression of mass gain on initial mass

\bar{x}_1 = mean initial mass for specific groups of fish

\bar{x}_2 = mean initial mass of all the tested groups of fish.

By using this approach, Wohlfarth and Moav (1972) could show that mass gains corrected in this manner were independent of variation within the initial mass of a group of fish and that results obtained in this way could be taken to serve as an estimate of the inherent growth capacity of such fish tested.

In 1958 and 1959 the Dinkelsbühl Aischgrund variety of the European common carp was introduced into the Transvaal (Lombard, 1961) to establish carp farming. In 1977 the Israeli Dor 70 variety of the common carp was imported into South Africa from Israel and distributed to the Marble Hall Provincial Fisheries Research Station, Transvaal, and the Tsolo College of Agriculture in Transkei (Schoonbee *et al.*, 1979; Schoonbee and Prinsloo, 1984). As a result of the prolonged inbreeding of the Aischgrund stock, a decision was taken to cross this variety with the Dor 70 Israeli common carp and to compare, under similar environmental conditions, the natural growth potential of the three strains concerned (Prinsloo and Schoonbee, 1984 a, b, c). It is known from experience that the Aischgrund variety, having been developed for conditions in Central and Northern Europe, can actively feed and grow at water temperatures well below 20°C, whereas the Dor 70 strain, which was developed in the Mediterranean region with a warmer climate, grows better at temperatures exceeding 20°C. Compared to Israel, summer conditions of Transkei must be considered as mild with cold spells. In the spring months to as late as September, pond water temperatures decline to below 20°C. Climatic conditions would, therefore, appear to favour the Aischgrund carp. The answer which the authors were looking for was whether the crossbreed might inherit superior qualities from both the Dor 70 and Aischgrund parental stock, especially with respect to feeding and growth under the colder water conditions prevailing in Transkei.

Materials and methods

Three varieties were used viz. the Dinkelsbühl Aischgrund variety (Lombard, 1961); the Israeli Dor 70 variety (Wohlfarth *et al.*, 1980); and the Israeli Dor 70 x Aischgrund crossbreed (Cronje, 1981).

Spawning of the fish took place at the Umtata Dam Fish Research Centre (Schoonbee and Prinsloo, 1984). Juveniles were reared in special rearing ponds to an approximate size of 2,5 g, after which a set of two 400 m² ponds was used for each variety to differentiate in size groups within each variety by stocking fishes under low and high density conditions (12 500 and 25 000 fish per ha). All fish were fed daily on a diet of 45 % protein trout meal at an adjusted ratio of approximately 5 % of the total fish biomass at a given time. Growth of fish in the respective ponds was monitored on a weekly basis for 45 days.

With the exception of the smaller fishes of the Aischgrund variety stocked under high density conditions, and which were

still too small to be branded, all fishes belonging to each specific size group were specifically branded (Moav *et al.*, 1960) for identification purposes.

Combinations of equal numbers of the larger and smaller fish groups of all three varieties were then grown together with other fish species in three ponds. These were randomly selected from 18 ponds, where fish production experiments were carried out using pig, cattle and chicken manure, with and without the additions of pelleted fish feed (Prinsloo and Schoonbee, 1984 a, b, c). In this way the inherent growth potential of these fish during late summer and autumn in Transkei (160 days; January – June 1982) was established.

Coefficient of correction values obtained based on the relative growth performances of the different size groups of the three varieties concerned in the three specific ponds were then used to obtain the necessary corrected values of biomass gains (Table 1).

Discussion

The results of the observed and corrected biomass gains showed the Aischgrund x Dor 70 variety of the common carp to improve its position with time against the other two varieties over virtually the entire range of treatments applied (Table 1). This was particularly so in the case of the pond systems where manure and pelleted feed were employed as nutrients. Where chicken manure was used, the situation was, however, not so good, so that in the corrected figure the biomass gain of the crossbreed was similar to that of the Dor 70, but still much better than that of the Aischgrund. In the case where cattle manure was used, however, the Dor 70 and Aischgrund x Dor 70 crossbreed varieties were similar and clearly the best growth performers. Once pelleted fish feed was given together with the various manures, the Aischgrund x Dor 70 crossbreed became the best grower for all three manure types and fish pellet combinations used. The crossbreed was

TABLE 1
COMPARISON OF EMPIRICAL (Y') AND CORRECTED (Y) BIOMASS GAINS OF THE THREE VARIETIES OF COMMON CARP GROWN IN POLYCULTURE WITH OTHER FISH SPECIES WITH THE USE OF PIG, CATTLE AND CHICKEN MANURE WITH AND WITHOUT PELLETTED FISH FEED. (A: AISCHGRUND; D: DOR 70; A x D: AISCHGRUND X DOR 70 CROSSBREED; AND b: COEFFICIENT OF CORRECTION)

Sets of 3 ponds and treatment	Carp Variety	Mean initial biomass (\bar{X}_1) and final mean biomass (\bar{X}_2) in g	Deviation between initial (\bar{X}_1) and final (\bar{X}_2)	Amount of correction	Biomass gain in g			
					Observed (Y')	%	Corrected (Y)	%
Pig manure	A	14,5	- 0,6	+ 0,9	251,4	28,9	252,3	28,7
	D	32,4	- 1,2	+ 5,6	301,3	34,6	306,1	34,8
	A x D	32,9	- 0,6	+ 2,8	317,5	36,5	320,3	36,4
TOTAL					870,2		878,7	
Pig manure and pellets	A	11,5	- 3,6	+ 5,2	661,8	27,1	667,0	27,0
	D	26,7	- 4,5	+ 21,1	832,4	34,1	853,5	34,6
	A x D	33,0	- 0,5	+ 2,3	944,8	38,7	947,1	38,4
TOTAL					2 439,0		2 467,6	
Cattle manure	A	29,8	+ 14,7	- 21,2	194,0	26,6	172,8	26,1
	D	39,1	+ 7,9	- 37,1	278,9	38,2	241,8	36,6
	A x D	36,0	+ 2,5	- 11,5	257,6	35,3	246,1	37,2
TOTAL					730,5		660,7	
Cattle manure and pellets	A	10,5	- 4,6	+ 6,6	545,8	27,8	552,4	28,3
	D	29,9	- 1,3	+ 6,1	694,6	35,5	700,7	35,9
	A x D	32,3	- 1,2	+ 5,5	724,3	36,8	729,8	37,4
TOTAL					1 964,7		1 982,9	
Chicken manure	A	13,6	- 1,5	+ 2,2	170,5	29,5	172,7	29,0
	D	29,0	- 2,2	+ 10,3	201,4	34,9	211,7	35,6
	A x D	32,4	- 1,1	+ 5,1	205,6	35,6	210,7	35,4
TOTAL					577,5		595,1	
Chicken manure and pellets	A	10,8	- 4,3	+ 6,2	512,3	25,4	518,5	25,6
	D	30,2	- 1,0	+ 4,1	706,5	35,0	710,6	35,1
	A x D	34,6	+ 1,0	- 5,1	799,4	39,6	794,3	39,2
TOTAL					2 018,2		2 023,4	

\bar{X}_2 : A = 15,1; D = 31,2; A x D = 33,5
b : A = 1,44; D = 4,70; A x D = 4,60

without doubt also the most outstanding grower in the case where pig and chicken manure was combined with pelleted fish feed.

It was further found that the results obtained in this study in the case of the corrected biomass gain figures do not contradict the actual observed characteristics of the three common carp varieties. Of the three varieties under consideration, the Aischgrund x Dor 70 crossbreed appears to be the most docile and domesticated fish of all three varieties. In contrast, the Aischgrund variety always appears to be the wildest of the three, being the most difficult to be captured by fish eating birds as well as in seine nets. It also appears as if the Aischgrund variety has the better ability to utilise the benthic macro-invertebrate organisms which develop in the fish ponds. On the other hand, the Aischgrund x Dor 70 crossbreed variety repeatedly showed itself to be the first fish of the three varieties to be able to manipulate the demand feeder, which substantiates the findings on both the observed and corrected biomass gains in the present study. These results also support earlier observations by Cronje (1981), namely that the crossbreed commences feeding much sooner during early spring than even the colder water adapted Aischgrund carp variety. The Aischgrund x Dor 70 crossbreed variety does not appear to be easily scared by movements in the vicinity of the demand feeders and for this reason may be more subject to predation by fish-eating birds than, for instance, the Aischgrund carp. This characteristic is also confirmed by the findings of Prinsloo and Schoonbee (1984a, b, c).

From the results obtained, it appears that where proper supervision can be kept to prevent fish-eating birds from entering the ponds, and where pelleted fish feed is provided as food, the Aischgrund x Dor 70 crossbreed variety of the common carp is probably the best grower under conditions in Transkei of all three varieties under consideration, followed by the Israeli Dor 70 common carp.

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