Reproductive parameters of common carp (Cyprinus carpio L) spawners during natural season and out-of-season spawning

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SUMMARY

Common carp spawning characteristics were compared between season and out-of-season periods. There were no differences in the percentage of ovulation, spermatozoa motility and embryo survival to the eyed-egg-stage between the spawning periods. Fish spawned during the season produced oocytes of higher total weight than those spawned out-of-season. On the day exogenous feeding began, larvae obtained in out-of-season spawning were shorter than those obtained during the spawning season. However, the out-of-season larvae started feeding two days earlier than in-season larvae. As a result, seven days after fertilization, larvae obtained during out-of-season had the same length as larvae obtained during season. It appears to be possible to obtain common carp larvae half a year before the natural spawning period without decreasing the quality of gametes and larvae.


Key words: common carp, reproduction, season spawning, out-of-season spawning, spawning success

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INTRODUCTION

Obtaining high quality gametes and larvae is one of the most important problems in modern aquaculture. Development of an aquaculture system requires intensive year-round production of fish. For this reason, methods of out-of-seasons spawning are necessary. Common carp (together with koi carp) is one of the most important freshwater fish species in aquaculture. Many different spawning agents are used in the artificial reproduction of carp [1-4], but in Poland, Ovopel is the main spawning agent for cyprinids [6]. The possibility to obtain gametes and larvae the entire year could enable the improvement of fish culture and the use of closed-recirculation water-systems. The aim of this study was to compare reproductive parameters of common carp spawning in May (during natural season) and in November (out-of-season).

MATERIALS AND METHODS

Common carp spawners were obtained from Halinów Fish Farm and were moved to the hatchery at the Department of Lake and River Fisheries, University of Warmia and Mazury in Olsztyn. The fish were transported to Olsztyn in May (natural spawning season) and November (out-of-season). Fish used in both experiments originated from the same cultured stock. The weight of female spawners ranged from 1.9 to 2.8 kg and male from 1.1 to 2.0 kg. All fish were 3+ years old. Males and females were kept together in 1000 l tanks with controlled temperature and photoperiod [9]. Water temperature and photoperiod in the hatchery were gradually raised during 12 days from 10 to 20°C and 12 to 14 hours of light, respectively. The same temperature and photoperiod regimes were applied to both fish groups. Fish were individually marked using floy tags and weighed. Oocytes were sampled [8] and placed in Serra’s solution to increase transparency of the cytoplasm. After five minutes, the position of the oocyte nucleus (a marker of oocyte maturation) was determined using a four-stage scale:
- stage 1: germinal vesicle (GV) in central position,
- stage 2: early migration of germinal vesicle (less than half of the radius),
- stage 3: late migration of germinal vesicle (more than half of the radius),
- stage 4: peripheral germinal vesicle or germinal vesicle breakdown (GVBD).

The only-females used for further experiments had oocyte maturation during stage 3 or between stages 2 and 3 which are the best moments for hormonal stimulation in cyprinids. Such oocytes occurred in all females during in-season spawning and only in 60% females during out-of-season spawning (6 out of 10). Fish were anaesthetized with 2-phenoxyethanol (0.5 mg/dm³) before all manipulations. Ovopel (Unitrade, Hungary) pellets containing GnRHa and dopamine antagonists were used to induce spawning [5]. The pellets were pulverized in a mortar and dissolved in 0.9% NaCl. Two intraperitoneal injections of Ovopel (0.2 and then 1.0 pellets/kg BW) were performed at 12-h interval at the base of the pelvic fin. Females were checked every three hours between 12 and 24 hours after the last Ovopel injection. Eggs were stripped into a plastic vessel and fertilized by „dry method”. Milt was collected with plastic syringes and stored at 4°C until used for fertilization. Within 30 min after collection, the motility of spermatozoa was estimated under a microscope (magnification 500×) after activation in 0.5% NaCl. Three samples of eggs from each female (100-150 oocytes per each sample) were placed in Petri dishes and fertilized by pooled milt. The eggs were incubated in a recirculating system (20°C). Statistical differences between the two groups were analyzed using *t-test* (p<0.05).

**RESULTS AND DISCUSSION**

The results of in-season and out-of-season spawning of common carp were similar (tab. 1). There were no differences in the percentages of spermiation, ovulation as well as spermatozoa motility. However, a significant difference was observed for the latency time i.e. time between the second Ovopel injection and ovulation. Carp females ovulated earlier during in-season spawning and produced higher egg weight as compared to out-of-season spawning. This is probably related to a much shorter time of egg development occurring in the latter group.
Table 1. Characteristics of season and out-of-season spawning of common carp

<table>
<thead>
<tr>
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<th>Out-of-season (November)</th>
<th>Season (May)</th>
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<tbody>
<tr>
<td>Males (n)</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Males spermiation (%)</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Spermatozoa motility (%)</td>
<td>88±2.7(^a)</td>
<td>86±5.5(^a)</td>
</tr>
<tr>
<td>Females (n)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Percentage of ovulation</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
<td>Latency time (h)</td>
<td>16.2±3.4(^a)</td>
<td>13.5±2.2(^b)</td>
</tr>
<tr>
<td>Eggs weight g/kg BW females</td>
<td>58.1±17.6(^a)</td>
<td>103.8±31.8(^b)</td>
</tr>
<tr>
<td>Egg survival to the eyed-egg-stage (%)</td>
<td>81.5±5.4(^a)</td>
<td>77.7±6.7(^a)</td>
</tr>
<tr>
<td>Percentage of abnormal larvae</td>
<td>2.1±0.5(^a)</td>
<td>1.7±0.6(^a)</td>
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<td>Start of exogenous feeding (days)</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Total length of larvae on the day the exogenous feeding started (mm)</td>
<td>5.3±0.2(^a)</td>
<td>6.8±0.3(^b)</td>
</tr>
<tr>
<td>Total length of larvae on day 7 after fertilization (mm)</td>
<td>6.9±0.2(^a)</td>
<td>6.8±0.3(^a)</td>
</tr>
</tbody>
</table>

Data marked with the same letter did not differ significantly (p>0.05)

There were no differences in embryo survival at eyed-egg-stage and percentage of abnormalities in hatched larvae. This suggests that the biological quality of gametes was similar for both spawning periods. These data are in contrast to the results obtained by researchers studying other cyprinids (i.e. ide) who observed lower quality of gametes in out-of-season spawning [7, 10]. In our experiment, on the day exogenous feeding started, larvae from out-of-season spawning were shorter than those obtained during in-season spawning (tab. 1). However, the out-of-season larvae started feeding two days earlier than in-season larvae. Larval size and lack of abnormalities are among the major factors used for the description of spawning success. Smaller larvae are usually considered as of inferior quality. Smaller larvae size, observed in our study, resulted probably from a much shorter period of vitellogenesis as well as smaller oocyte weight. However, we have found that seven days after fertilization,
the larvae obtained out-of-season had the same length as larvae obtained in-season. Results of this study demonstrated that it is possible to obtain common carp larvae half a year before the natural spawning period without decreasing the quality of gametes and larvae.

REFERENCES