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Production Systems

Loading of integrated fishponds with organic matter under different approaches of mule ducks (*Anas platyrhynchos* x *Cairina moschata*) feeding

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(Manuscript received 11 November 2009; accepted for publication 18 November 2009)

Abstract. *The effect of the feeding regime of mule ducks on loading of fishponds with organic matter in integrated fish-cum-duck technology was studied at the Institute of Fisheries and Aquaculture – Plovdiv. The stocking density of the ducklings was 340 pcs.ha⁻¹. The coefficient of loading () was used for establishing*

the pond loading: $M = \frac{N(96W)}{P} r$, where N is the mean number of ducks in the rotation; t – rotation length in days; W – average live weight of the

ducks for the growing period, kg; 96 g – the amount of the manure released for a day by one duck per kg of live weight; P – pond surface area, ha; r – relative stay of the ducks in water out of the active time of days. Two regimes of feeding the mule ducks were studied. It was established that when fed on a balanced mixture, the mule ducks spent the bigger part of the day on land, as a result of which during the period of the study (40 days) the manure inserted in the pond amounted to 74.7 kg.ha⁻¹. Substituting 50 % of the mixture with wheat, maize or sunflower groats (preserving the energy and protein levels), led to prolonging the average length of stay of the mule ducks in the pond almost 8 times. Due to the more significant differences in the time spent in the pond during the last ten-day periods, the manure released into water increased by more than 10 times, although the live weight in all the periods was lower compared to the first variant.

Keywords: fish-cum-duck integration, manure, behavior, method

Introduction

The integration of aquaculture with other animal breeding branches is important from the point of view of the stable development of agriculture (Little and Edwards, 2003). Of all types of integration, the technology for integrated breeding of ducks and fish is the most harmonic one. Ducks are pretty good meliorators. They introduce organic matter into the fishpond uniformly during the total period of breeding (Tripathi and Sharma, 2001). At the same time the excessive quantities of organic matter might cause considerable damages. Concerning this Gabriel et al. (2007) indicate that when establishing environmentally friendly integrated systems it is very important to record the exact quantity of organic matter introduced by the birds. One of the decisive factors for the ducks' effect upon the fishpond is the duration of their stay in it.

Little and Edwards (2003) have indicated that probably a very small quantity of manure produced by ducks bred in integrated systems has gone into the fishpond. The quantity of manure, which goes into the integrated fish-pond depends on the breeds of ducks used, on the methodologies of their breeding and on approaches of feeding (Bao-Tong and Hua-Zhu, 1984; Little and Satapornvanit, 1996). Different species and breeds of birds, including mule ducks have been used in integration (Stevens and Sauveur, 1985; Fujihara

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et al., 1997; Pingel, 1997;). Mule ducks are hybrids of Peking and Muscovy ducks, which are biologically different (Rodenburg et al., 2005 etc.). Concerning Muscovy ducks it has been known that they prefer to stay on dry land. Regarding mule ducks it has been indicated that if they have an access to the fishponds they prefer to go into the water (Matull and Reiter, 1995) but as regards their behavior they have been closer to Muscovy ducks (Hoffmann, 1992). The waterfowl birds have an influence upon the fishpond ecosystem by means of the functions they carry out in the water. A number of investigations have shown that when fed on full ration mixtures birds cannot utilize efficiently the free areas at their disposal (Bubier and Bradshaw, 1998; Dawkins et al., 2003). In order to stimulate the active behavior of birds in the free ecosystems of their breeding, different systems of restrictive nutrition have been investigated (Christensen and Nielsen, 2002; Horsted, 2006). The fishpond supplies waterfowl birds with food sources of vegetable and animal origin, because of which it is very important to be assimilated by the birds, at the same time carrying out pest and overgrowth protection, aeration of water and in the first place, applying manure to the fishponds. By this investigation we have set the aim to investigate the loading of integrated fishponds with organic matter under different approaches of mule ducks feeding.

Material and methods

The experiment has been carried out at the Institute of Fisheries and Aquaculture – Plovdiv. During the preparatory period the mule ducks have been bred in a solid building. They have been fed *ad libitum* on balanced mixtures.

For the purposes of the experiment, at the end of the preparatory period (4 weeks' age), two groups of mule ducks have been formed. They have been placed in two neighboring carp fattening fishponds, enclosed by a wire-net, at a density of 340 pcs.ha⁻¹. Light shelters have been built on fishpond dikes and the ducks have had an unlimited access to the pond-area day and night. The fishponds have been planted by two-year-old common carp (*Cyprinus carpio* L.)-1400 pcs.ha⁻¹, grass carp (*Ctenopharyngodon idella* Val.)- 100 pcs.ha⁻¹ and bighead carp (*Aristichthys nobilis* Rich.) – 800 pcs.ha⁻¹. Grain fodder has been used for fish feeding and the feeding-troughs have been enclosed with wirenets to exclude ducks' access there.

During the experimental period each duck has been supplied with 0.200 kg of fodder per day. The food has been given twice a day, upon the fishpond dike. In one of the fishponds (variant Ist 82 ducks) the ducks have been fed on balanced commercial mixture containing 18.2% crude protein; 12.2 MJ.kg⁻¹ exchangeable energy; 3.8% dry matter; 0.868% lysine; 0.657% methionine+cystine; 2.7% crude fat; 0.954% Ca; 0.679% . In the other fishpond (IInd 45 ducks) variant, 50% of the commercial mixture was substituted with a mixture prepared on the farm, based on wheat, maize and sunflower groats, without using mineral forages and biologically active substances. Duckling weight gain was controlled by weighing the individuals every decade (from 30 to 70 - day age)

In both ponds the physical and chemical characteristics of water have been within the technological standards. For determining the duration of the ducks' stay in the fishpond and calculating the respective coefficient (r), behavioral monitoring has been done. Five 10-hour long monitorings have been carried out during the light part of the 24 hours - period (from 8 a.m. till 6 p.m.) with 7 days' intervals. The fishpond loading per each one of the four decades of breeding has been determined by using an organic matter loading

coefficient (M) (Nikolova, 2003): $M = \frac{Nt(96W)}{P} r$, where N is the mean

number of ducks in the rotation; t – rotation length in days; W – average live weight of the ducks for the growing period, kg; 96 g – the amount of the manure released per day by one duck per kg of live weight (according to Little and Muir, 1987); P – pond surface area, ha; r – relative stay of the ducks in water out of the active time of days. The data have been variation-statistically processed.

Results and discussion

Table 1 presents the indices determining and characterizing loading of experimental fishponds with ducks during the period of breeding at the applied approaches of feeding.

The way of feeding has affected both components concerning organic matter quantity introduced into the fishponds – ducks' growth and their behavior within the integrated production system, the second component being the leading one. However, during the first decade of the integrated period the difference in ducks' live weight from both groups has been 1.5%, while according to the quantity of organic matter introduced into the fishpond it has comprised 227%. This difference has been determined by the values of the "r" coefficient, which characterizes the relative duration of ducks' stay in the water of the time of the active part of the day. Concerning the ducks from the second group, it has been 2.26 times higher compared to the first group. The significance of ducks' stay in the fishpond regarding organic matter quantities, introduced in it has been illustrated in Figure 1.

When fed on balanced mixture mule ducks preferred to be on dry land and the organic matter left by them remained on fishpond dikes. With age the duration of stay in the water has decreased by approximately 6 times. It is only the 4th decade, which makes an exception, during which the birds have shown a higher activity to the pond.

The changes that have taken place in modern animal-breeding, concerning the level of increase of eco- and bio-conformity of breeding technologies, have set a number of problems to be solved. Dawking et al. (2003) have indicated that when breeding chicken-broilers in commercial free-range systems, most of the birds do not go out into the free-range space in front of the buildings preferring to stay inside. In search for possibilities for foraging activity increase different methods of restrictive nutrition have been investigated.

Table 1. Indices determining the loading of experimental fishponds with ducks during the period of breeding

Decads of rearing	- variant			- variant				
	Live weight, kg		r	Introduced manure for each decads, g.ha ⁻¹	Live weight, kg		r	Introduced manure for each decads, g.ha ⁻¹
	LS	±SE			LS	±SE		
1	0.527	21.1	0.066	11.41	0.535	17.4	0.149	25.90
2	0.830	24.7	0.031	8.44	0.790	33.9	0.131	33.63
3	1.408	35.9	0.014	6.47	1.355	48.7	0.315	138.69
4	2.034	34.2	0.059	39.36	1.980	54.5	0.474	304.95
5	2.770	53.4	0.010	9.09	2.211	39.0	0.364	261.5
Total	-	-	-	74.77	-	-	-	764.67

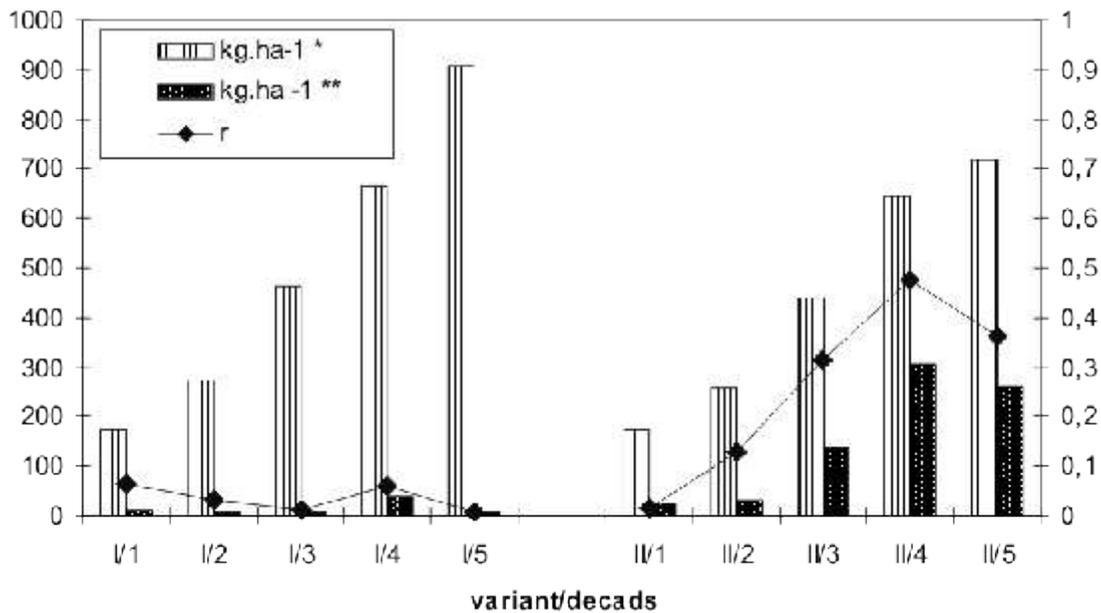


Figure 1. Effect of ducks' stay in the fishpond upon organic matter levels introduced in it (*kg.ha⁻¹ - without taking into account 'r'; **kg.ha⁻¹ - by taking into account 'r')

Christensen and Nielsen (2002) have not established the foraging activity increase expected in search for food, because of calcium insufficiency in the ration of broilers bred in free-range systems. Nielsen et al. (2003) have established that broilers fed on low-energy rations prefer to spend more time on the free-range areas in front of the buildings than those fed on high-energy rations.

At the conditions of the experiment, the replacement of 50% of the mixture with grain fodder and groats (preserving the energy and protein levels) has led to increasing of mule ducks' stay in the fishpond. During the first decade the ducks from the second variant have stayed in the water two times longer in comparison with the first variant. During the next decades, the duration of stay in the water has increased, instead of decreasing as it has been in the first variant, and it has increased by the fourth decade by approximately 3.2 times. This in its turn has led to a considerable increase of organic matter quantity introduced into the fishpond. Regardless of the fact that from the second to the last decade the ducks from the second variant have had lower live weight, the organic matter quantity introduced during the separate decades has been from 4.0 to 28.7 times more as compared to the first variant. It should be noted that in the second variant of feeding, from the first to the fourth decade, the organic matter quantity has gradually increased, while in the first variant the change has been non-linear.

Concerning the total period of breeding, when fed on balanced mixture mule ducks have introduced approximately 74.77 kg.ha⁻¹ of organic matter, while in the second variant this quantity has been 10 times more. In the investigation upon restrictive nutrition of mule ducks at free-range breeding carried out by Pingel (1999), it has been established that the birds have had lower levels of growing, but however, had utilized forage better (FCR). The author has concluded that mule ducks were suitable for breeding at free-range pasture systems.

The results from the experiment carried out have shown that when using highly productive hybrids of ducks into the integrated

systems, we should seek for a balance between obtaining high results in bird fattening and achieving maximum environmental and bio-friendliness of the technology. Supplying the ducks with high-quality food has ensured higher growth rates but has led to decrease of their stay in the water, by which the ducks' role in the integrated system has been decreased.

At limited feeding, lower growth rates have been achieved, however mule ducks have been growing well and have been in a good health status and feathering. No demonstrations of aggressiveness and cannibalism – the main problems of breeding in intensive production systems – have been observed. The lower live weights of mule ducks have been compensated by their higher activity and longer stay in the water. In this way we have ensured not only a bio-friendly medium for the mule ducks themselves, but a possibility to execute their functions for dunging and melioration of the fishponds, as well.

Conclusion

When fed on balanced mixture during the greater part of the day, mule ducks have remained on dry land, as a result of which during the period of their breeding in the fishpond they have introduced organic matter quantity of approximately 74.77 kg.ha⁻¹. The replacement of 50% of the mixture with grain fodder and sunflower groats (preserving the energy and protein levels) has led to increase of the average mule ducks' stay in the fishpond by nearly 8 times, and with age the duration of stay in the water has gradually decreased. As a result, in the second variant, the fishpond loading with organic matter has been 10 times higher as compared to the first variant, regardless of the fact that the live weight during all periods has been lower.

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