



Inheritance of plumage colour in Japanese quails

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Plumage colour variation in birds has a strong genetic component. A number of quail plumage variations were studied, several linkage and epistatic relationships explored (Minvielle *et al.* 2003) and, new loci described (Tsuzuki 2008). Several plumage colour genes were mapped like silver (Minvielle 2010) and lavender (Bedhom *et al.* 2012). Different plumage colour genotypes affect hatchability, body weight and egg production traits in Japanese quails (Dowarah and Sethi 2013, Islam *et al.* 2014), which emphasize the need to study plumage colour genetics.

A complete 4 × 4 diallel cross involving 480 sires and equal number of dams (120 from each line) using 4 populations of Japanese quail namely CARI-Uttam, CARI-Ujjwal, CARI-Sweta and CARI-Pearl was carried out. These 4 quail populations are maintained as closed flocks at Central Avian Research Institute, Izatnagar. Both CARI-Uttam and CARI-Pearl possessed a wild type of plumage called as Pharaoh and other two, CARI-Ujjwal and CARI-Sweta possessed White breasted and White plumage pattern, respectively. The fertile eggs collected from all the mating combinations were labeled. Eggs were cleaned and stored before setting them in an automatic incubator. Eggs were incubated for 17 days (14 days setter plus 3 days hatcher) using pedigree boxes for the last 3 days. During hatching, day-old chicks from each cross were identified and counted on basis of plumage (down colour) as Pharaoh, White breasted and White to arrive at respective proportions.

Both the absolute values (numbers) of progeny plumage colour as well as proportion of the progeny carrying different plumage types along with the putative genotype of parents and progeny are presented in Table 1. From 16 crosses, 4 crosses involved Pharaoh males and females, 1 cross each of White breasted males and females and White males and females, 2 each of Pharaoh × White breasted and Pharaoh × White, reciprocal of these 2 crosses, 1 cross of White breasted × White and its reciprocal cross.

All the 4 crosses involving Pharaoh parents gave rise to

Pharaoh progenies only. The crosses involving Pharaoh and White breasted parents yielded progeny that were predominantly White breasted (60–80%), followed by Pharaoh (15–30%) and White (1–18%). However, visible differences between the reciprocal crosses of Pharaoh and White breasted particularly with respect to proportion of White plumage colour were observed. Pharaoh × White breasted produced 1% White plumage chicks, while as White breasted × Pharaoh (reciprocal cross) had 11% White chicks. Similarly, a cross of White breasted × White gave rise to a progeny comprising 90% White breasted and 10% White chicks, but its reciprocal cross produced 30% Pharaoh, 65% White breasted and 5% White off-springs. Lastly inter-se cross of White breasted gave rise to 87.5 and 12.5% White breasted and White chicks, respectively, and the inter-se cross of White yielded White off-springs only.

White × White cross produced only White progenies, Pharaoh × Pharaoh predominantly Pharaoh progenies and a few Whites, and White breasted × White breasted gave rise to White breasted and Pharaoh when compared with the fact that cross of Pharaoh × White gave rise to more of Pharaoh and less of white and, White breasted × Pharaoh gave rise to more of White breasted, followed by Pharaoh and White in that order, led us to infer that White breasted should be dominant over non-white breasted and Pharaoh be dominant over White. Accordingly, putative genotypes were worked out (Table 1) for parents and offsprings involving two loci. White breasted (Wb/wb) and Panda (S/s). Mention needs to be made that White plumage variant used in our study was described as a recessive mutation termed as ‘Pand’ and ‘Dotted white’ (Tsudzuki *et al.* 1993). Both the variants were present in our quail population, but for the purpose of this study they were referred to as whites only. The plumage colour distribution in CARI-Ujjwal population termed as White breasted in this study did not exactly match the description of White breasted quail population as described by Cheng and Kimura (1990) and in contrast to our findings, Cheng and Kimura (1990) described White breasted plumage pattern as a recessive trait. However, Mishra *et al.* (2011) who also studied inheritance of White breasted plumage in CARI-Ujjwal population have described it as dominant mutation. The recessive nature of White ‘s’ was also reported by Miwa *et al.* (2006) and Mishra *et al.* (2011).

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Table 1. Plumage pattern of progeny of different crosses in a diallel experiment

Cross	Parents		Progeny							
	Plumage	Putative genotype	Numbers			Proportions				
			PH	WB	W	Total	PH	WB	W	
CU×CU	PH×PH	wbwbS ₋ × wbwbS ₋	207	0	0	207	1.00	0.00	0.00	wbwbS ₋ *
CU×CJ	PH×WB	wbwbS ₋ × Wb__S ₋	22	126	1	149	0.15	0.85	0.01	WbwbS ₋ WbwbS ₋ *
CU×CS	PH×W	wbwbS ₋ × wbw/bss	118	0	13	131	0.90	0.00	0.10	wbwbS ₋ /WbwbS ₋
CU×CP	PH×PH	wbwbS ₋ × wbwbS ₋	36	0	0	36	1.00	0.00	0.00	wbwbS ₋ *
CJ×CJ	WB×WB	Wb__S ₋ × wbw/bss	28	76	23	127	0.22	0.60	0.18	WbwbS ₋ Wb__ss/wbwbS ₋
CJ×CJ	WB×WB	Wb__S ₋ × Wb__S ₋	18	116	0	134	0.13	0.87	0.00	Wb__S ₋ /Wb__ss/wbwbS ₋ *
CJ×CS	WB×W	Wb__S ₋ × wbw/bss	0	134	15	149	0.00	0.90	0.10	Wb__S ₋ /Wb__ss/wbwbS ₋
CJ×CP	WB×PH	Wb__S ₋ × wbwbS ₋	49	103	6	158	0.31	0.65	0.04	WbwbS ₋ WbwbS ₋ /WbwbS ₋ *
CS×CU	W×PH	wbwbS ₋ × wbwbS ₋	146	0	0	146	1.00	0.00	0.00	WbwbS ₋ WbwbS ₋ /WbwbS ₋ *
CS×CJ	W×WB	wbwbS ₋ × Wb__S ₋	51	110	8	169	0.30	0.65	0.05	Wb__S ₋ /Wb__ss/wbwbS ₋
CS×CS	W×W	wbwbS ₋ × wbw/bss	0	0	126	126	0.00	0.00	1.00	Wb__ss/wbwbS ₋
CS×CP	W×PH	wbwbS ₋ × wbwbS ₋	111	0	5	116	0.96	0.00	0.04	wbwbS ₋ Wb__ss/wbwbS ₋
CP×CU	PH×PH	wbwbS ₋ × wbw/bss	174	0	2	176	0.99	0.00	0.01	wbwbS ₋
CP×CJ	PH×WB	wbwbS ₋ × Wb__S ₋	43	100	0	143	0.30	0.70	0.00	WbwbS ₋ WbwbS ₋ *
CP×CS	PH×W	wbwbS ₋ × wbw/bss	153	0	11	164	0.93	0.00	0.07	WbwbS ₋ WbwbS ₋ /WbwbS ₋
CP×CP	PH×PH	wbwbS ₋ × wbwbS ₋	128	0	5	133	0.96	0.00	0.04	wbwbS ₋

Strains used: CU, CARI Utram; CJ, CARI Ujjwal; CS, CARI Sweta; CP, CARI Pearl. Plumage colour: PH, Pharaoh; WB, White breasted; W, White. *, putative genotypes of progeny which were expected on the basis of putative genotype of parents but were not obtained.

The results indicated dominant nature of White breasted and the recessive nature of White feather colour mutations. Therefore the inheritance of plumage colours Pharaoh, White breasted and White could be explained on the basis of 2 autosomal plumage color loci. For the locus coding for White breasted, the ‘Wb’ (White breasted) appears to be dominant over ‘wb’ (non White breasted) while at the other unlinked locus, ‘ss’ resulted into White plumage pattern, and S₋ was the genotype associated with pharaoh plumage.

SUMMARY

A complete 4 × 4 diallel cross involving 4 quail populations, 2 of which possessed Pharaoh, plumage and other 2, White breasted and White plumage pattern was performed and the plumage colour of progeny in different crosses was recorded. The results indicated dominant nature of White breasted and the recessive nature of White feather colour mutations. The inheritance of plumage colours of Pharaoh, White breasted and White could be explained on the basis of two autosomal plumage color loci

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