Website : www.asthafoundation.in
Progressive Research : An International Journal
Vol 19 (1) : 22-27 (January-2024), Print ISSN : 0973-6417, Online ISSN : 2454-6003
Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India

Evaluation of Growth, Production and Reproduction Performance Traits of Dahlem Red and their Crosses with Native Breeds in the Agro Climatic Conditions of Bihar

Vinita Yashveer, Ravikant Nirala[2*], Ravi Ranjan Kumar Sinha[2], Sudha Kumari[3], Dhirendra Kumar[4] and Pragya Bhadauria[5]

[1]*Department of AGB, BVC, Patna, Bihar*
[2]*Department of LPM, BVC, Patna, Bihar*
[3]*Department of VMC, BVC, Patna, Bihat*
[4]*Department of AGB, COVAS, Kishanganj, Bihar*
[5]*ATARI, Patna, Bihar*
**Corresponding Author Email : drravikantnirala@gmail.com*

Abstract

India is heavily facing nutritional deficiency due to mismatch of rising population and availability of quality food. Only plant sources cannot fulfil the requirement of quality protein in pace with its rising demand in our country. The Kadaknath and Aseel breed are the, most important indigenous breeds in our country. Kadaknath exhibit intense black colouration, which is due to the deposition of Melanin pigments in the connective tissue of organs and in the dermis). These birds are poor in egg production potential, but their black flesh is very delicious and popular among tribal people. Sometimes the flesh is being used for the treatment of many diseases by tribal, which needs proper scientific intervention.

Key words : *Dahlem red aseel kadaknath, hybrid vigor, feed conversion ratio traits agro climatic conditions.*

Introduction

In this direction, the cheapest egg in the form of backyard farming, which is produced by backyard poultry that lives on scavenging, foraging and feeding on kitchen waste. White leghorn and Dahlem Red produce more range of eggs. Due to presence of colour inhibiting genes the crossbreed chicken of White leghorn will be White in colour, whereas crossbreed chicken of Dahlem Red will have coloured plumage. Farmers in general, prefer chicks of colour plumage than the white plumage in the local desi birds. The production potentiality, adaptability and disease resistance of Aseel and Kadaknath have not yet been studied in agro climatic conditions of Bihar. Hence, Dahlem Red (German origin) may be used as an exotic genetic resource for crossing with Aseel and Kadaknath. The number of eggs produced should not be the only criteria, but due emphasis should also be given to the egg weight and other egg quality traits. For example, a good internal quality egg can stand better preservation than the poor quality eggs. Good external quality egg ensures a good percentage of hatchability, transportation to wider area and thus making poultry more profitable. The success of poultry farming in backyard system largely depends upon egg quality and egg number.Native chicken is bestowed with favourable traits such as higher genetic diversity, disease resistance, ability to thrive under less favourable conditions, *etc*. The egg/meat from native chicken get a better price owing to its consumer preference for their taste, flavour and texture of meat. The meat of native fowl has significantly higher amino acid contents (arginine and lysine) than meat from exotic birds. Crossbreeding can be used as a tool that allows manipulating genetic variation to change the populations in a fashion that attempts to optimize desired phenotype. Crossbreeding therefore is an essential part of modern breeding programs in poultry that exploit genetic variations. The main purpose of crossing is to produce superior crosses to improve fitness and fertility traits and to combine different characteristics in which the cross breeds were valuable (1). Hybrid vigor (or Heterosis) has become a routine tool for poultry breeders to produce progeny that exhibit more desirable phenotype than those of their parental populations (2).

Materials and Methods

Experimental location : The present study was conducted on 500 birds (100 birds each from Aseel, Kadaknath, and Dahlem Red, Aseel x Dahlem Red and Kadaknath x Dahlem Red procured from CARI, Bareilly and maintained under deep litter system in PRT&C poultry research and training Centre of BASU, Patna. Germplasms of Aseel, Kadaknath and Dahlem Red birds were procured from CARI, Bareilly and maintained under deep litter system at PRT&C of the university :

1. Weekly body weight up to 20 weeks of age.

Received : October-2023; Revised : October-2023; Accepted : November-2023

Experimental Materials :

1. The following traits were recorded :

A. Growth traits :

Sl. No.	Genetic Groups	Mating ratio	No. of birds raised in each genetic group	Progeny stock of birds
1.	Aseel Aseel (99)	1M : 8F	5M : 40F	50 Birds
2.	Kadaknath Kadaknath (100)	1M : 8F	5M : 40F	50 Birds
3.	Dahlem Red Dahlem Red (138)	1M : 8F	5M : 40F	50 Birds
4.	Aseel Dahlem Red (80)	1M : 8F	5M : 40F	50 Birds
5.	Kadaknath Dahlem Red (100)	1M : 8F	5M : 40F	50 Birds

2. Monthly body weights from 6 to 12 months of age.

3. Growth rate up to 20 weeks of age.

4. Bi-weekly feed consumption from 0 to 20 weeks.

2. Feed conversion ratio

Feed conversion ratio (FCR) was calculated by using the following formula :

$$\text{Weekly FCR} = \frac{\text{Feed intake during the week}}{\text{Weekly gain in the body weight}}$$

Overall FCR at 20 weeks of age

$$= \frac{\text{Feed consumption in 20 weeks}}{\text{Gain in body weight in 20 weeks}}$$

A. Mortality rate : Weekly mortality and overall mortality was recorded from 1 to 20 weeks of age.

C. Productive traits :

1. Egg production data was taken from 20 weeks to 52 weeks of age.

2. Percent egg production from 20 to 52 weeks of age.

3. Part annual egg production.

I. Egg Production :

Weekly per cent Egg production from (20 to 52 weeks of age) -

(1) Eggs production up to 52 weeks of age

Egg production per bird

$$= \frac{\text{Total eggs laid upto 52 weeks of age}}{\text{Average No. of layers during the period}}$$

The laying period of 6 months were divided into 3 stages, viz–

1. Early stage (22-32 weeks)

2. Mid stage (33-42 weeks)

3. Late stage (43-52 weeks)

Results and Discussion

The various economic traits like weekly body weight from 0 to 20 weeks of age, 4 weekly/monthly body weight from 20 to 52 weeks of age were recorded. The parameters recorded for study were body weight gain, feed intake and feed conversion ratio (FCR) from 0 to 20 weeks of age. The other parameters taken were age at sexual maturity (ASM), part egg production up to 52 weeks of age and egg quality traits at 42 weeks of age, egg weight at different stages of egg production, hatchability, fertility and mortality up to 20 weeks of age were studied for five (5) genetic groups comprising three purebreds and two crossbreds.

Growth traits

Body weight : The least squares mean along with their standard errors (SE) for body weight of male and female as well as their overall means irrespective of sex under each genetic groups at weekly interval from 0 to 20th week of age are presented in table 4.1 to 4.3 and graph 1 to 10. Analysis of variance for the effect of hatch, sex and genetic groups on body weight of males and females has been presented in table 4.4. The analysis of variance revealed significant ($p=0.05$) effect of sex and genetic groups on body weight of males and females at all age groups from 0 to 20th weeks of age. However, significant ($P<0.05$) effect of hatch on body weight was found at the age groups on 1st, 3rd and 14th weeks of age.

It was evident from table 4.1 that among purebreds Aseel male recorded the highest body weight from 5th week onwards upto 20th weeks of age, but did not differ significantly ($P=0.05$) from the Dahlem Red male upto 10th week of age. Aseel males were significantly ($p=0.05$) heavier than the Dahlem Red male by 96 g at 11th week onwards upto 20th week of age. Almost similar trends were also observed in case of females. Aseel females were lighter than the Dahlem Red female upto 3rd week of age. Thereafter, Aseel females recorded higher body weight than the Dahlem Red female from 4th week onwards, but did not differ significantly ($P=0.05$) upto 10th week of age. Aseel females were significantly ($p=0.05$)

Table-2 : Least Squares Means ± Standard Error (SE) of body weight (gm) of Male of different genetic groups of chicken from 0-20 weeks of age.

Period	Sex	AS (gm)	KN (gm)	DR (gm)	ASXDR (gm)	KNXDR (gm)
N		99	100	138	80	100
HW		32.70^{b}±0.16	29.2^{a}±0.18	36.9^{d}±0.14	45.0^{e}±0.16	35.3^{c}±0.16
1st week	Male	40.2^{a}±0.19	40.5^{a}±0.19	58.2^{c}±0.17	63.7^{a}±0.21	56.7^{b}±0.19
2nd week	Male	72.3^{b}±1.08	54.2^{a}±1.07	109.1^{d}±0.96	103.2^{c}±1.17	56.28^{b}±0.16
3rd week	Male	110^{b}±3.21	79.8±1.49	169.0^{a}±2.76	159.5±1.64	178.3±1.47
4th week	Male	194.1^{b}±3.21	121a±3.03	203^{b}±3.75	256^{c}±3.34	255^{c}±2.99
5th week	Male	292^{c}±3.40	139a±3.18	261^{b}±3.95	350^{d}±3.49	351^{d}±3.14
6th week	Male	378^{b}±7.70	244^{a}±2.73	318^{b}±6.68	475^{d}±7.91	444^{c}±7.12
7th week	Male	465^{b}±8.22	280^{a}±7.69	450^{b}±7.20	560^{d}±8.38	508^{c}±7.59
8th week	Male	546^{b}±4.78	316a±5.08	545c±4.75	673d±5.53	674d±5.01
9th week	Male	660^{b}±5.79	349^{a}±5.40	649^{b}±5.20	768^{d}±5.92	721^{c}±5.36
10th week	Male	768^{c}±7.92	445^{a}±7.40	719^{b}±7.11	906^{e}±8.09	862^{d}±7.38
11th week	Male	849^{c}±8.27	489^{a}±7.82	753^{b}±7.55	1003^{d}±8.45	978^{d}±7.82
12th week	Male	983^{c}±7.01	582^{a}±6.62	826^{b} ± 6.39	1101^{e}±7.17	1045^{d}±6.62
13th week	Male	1081^{c}±7.27	634^{a}±6.87	895.0^{b}±6.65	1204^{d}±7.56	1067^{c}±6.87
14th week	Male	1193^{d}±7.60	780^{a}±7.18	1018^{b}±6.95	1284^{e}±7.90	1164^{c}±7.18
15th week	Male	1300^{d}±7.57	835^{a}±7.15	1112.0^{b}±6.92	1349^{e}±7.87	1265^{c}±7.15
16th week	Male	1465^{d}±10.76	922^{a}±10.16	1222^{b}±9.83	1458^{d}±11.18	1329^{c}±10.16
17th week	Male	1501.8^{d}±11.41	979^{a}±10.78	1283^{b}±0.45	1526^{d}±1.87	1355^{c}±10.78
18th week	Male	1556.0^{d}±12.39	1102^{a}±11.71	1464^{b}±11.34	1603^{c}±12.88	1465^{b}±11.71
19th week	Male	1608^{d}±12.95	1177.0^{a}±12.24	1595^{b}±11.86	1627^{c}±13.47	1565^{b}±12.24
20th week	Male	1758.0^{d}±15.90	1225.0^{a}±15.0	1689^{c}±14.5	1876^{c}±16.5	1695^{b}±15.1

Table-3 : Least Squares Means ± Standard Error (SE) of body weight (gm) of female of different genetic groups of chicken from 0-20 weeks of age.

Period	Sex	AS (gm)	KN (gm)	DR (gm)	ASXDR (gm)	KNXDR (gm)
N		99	100	138	80	100
HW		32.70^{b}±0.16	29.2^{a}± 0.18	36.9^{d}± 0.14	45.0^{e}± 0.16	35.3^{c}± 0.16
1st week	Female	39.3^{a} ± 0.17	39.7^{a} ± 0.17	57.4^{c} ± 0.15	62.9^{c} ± 0.19	55.8^{c} ± 0.17
2nd week	Female	64.3^{b} ± 0.97	46.2^{a} ± 0.97	91.0^{d} ± 0.84	95.2^{c} ± 1.08	$93.0.^{e}$ ± 1.06
3rd week	Female	97.5^{e} ± 1.35	70.8^{b} ± 1.24	137.2^{c}±1.35	150^{d} ± 1.51	168.8^{d} ± 1.36
4th week	Female	180^{b} ± 2.85	91^{a} ± 2.74	174^{b} ± 2.38	256^{c} ± 3.05	225^{c} ± 2.76
5th week	Female	266^{c} ± 2.99	113^{a} ± 2.84	234^{b} ± 2.49	324^{d} ± 3.17	325^{d} ± 2.87
6th week	Female	313^{b} ± 6.78	180^{a} ± 6.45	324^{b} ± 5.63	411^{d} ± 7.18	402^{c} ± 6.51
7th week	Female	404^{b} ± 7.19	219^{a} 6.84	389^{b} ± 6.06	508^{d} ± 7.60	477^{c} ± 6.90
8th week	Female	485^{b} ± 4.78	236^{a} ±4.51	484^{c} ± 4.00	593^{d} ± 5.01	563^{d} ± 4.55
9th week	Female	574^{b} ± 5.08	273^{a} ± 4.80	573^{b} ± 4.29	692^{d} ± 5.32	645^{c} ± 4.86
10th week	Female	659^{c} ± 6.94	336^{a} ± 6.60	609^{b} ± 5.77	796^{e} ± 7.27	753^{d} ± 6.66
11th week	Female	746^{c} ± 7.23	386^{a} ± 6.98	650^{b} ± 6.19	900^{d}±97.58	874^{d} ± 6.98
12th week	Female	859^{c} ± 6.12	458^{a} ± 5.91	701^{b} ± 5.24	977^{e} ± 6.46	921^{d} ± 5.91
13th week	Female	962^{c} ± 6.35	515^{a} ± 6.13	760^{b} ± 5.46	1084^{d}±6.83	947^{c} ± 6.87
14th week	Female	1070^{d}±6.64	656^{a} ± 6.41	895^{b} ± 5.71	1161^{e}±7.14	1070^{d} ± 6.64
15th week	Female	1171^{d}±6.16	705^{a} ± 6.38	947^{b} ± 5.69	1219^{e}±7.11	1136^{c} ± 6.38
16th week	Female	1280^{d}±9.39	737^{a} 9.06	1036^{d}±8.08	1272^{d}±10.10	1144^{c} ± 9.06
17th week	Female	1366^{d}±9.97	984^{a} ± 9.62	1088^{b}±8.61	1331^{d}±10.72	1160^{c} ± 9.62
18th week	Female	1447^{d}±10.82	875.5^{a}±10.44	1197^{b}±9.35	1136^{c}±11.64	1198^{b} ± 10.44
19th week	Female	1511^{d}±11.31	959^{a} ± 10.92	1255^{b}±9.77	1352^{c}±12.16	1290^{b} ± 10.92
20th week	Female	1549^{d} ± 13.8	1004^{a}± 13.4	1420^{c} ±12.0	1449^{c} ± 14.9	1288^{b} ± 13.5

Table-4 : Overall least Squares Means ± Standard Error (SE) of body weight (gm) of different genetic groups of chicken from 0-20 weeks of age.

Period	Sex	AS (gm)	KN (gm)	DR (gm)	ASXDR (gm)	KNXDR (gm)
N		99	100	138	80	100
HW		32.70^{b}±0.16	29.2^{a}±0.18	36.9^{d}± 0.14	45.0^{e}± 0.16	35.3^{c}± 0.16
1st week	Overall	39.76^{a}±0.17	40.09^{a}±0.18	57.81^{c}±0.14	63.31^{e}±0.18	56.28^{b}±0.17
2nd week	Overall	68.3^{b} ± 0.94	50.2^{a} ± 0.93	90.1^{d} ± 0.88	99.2^{c} ± 1.04	94.50^{e}±0.98
3rd week	Overall	102 ± 1.31	75 ± 1.29	132 ± 1.25	155 ± 1.46	174 ± 1.29
4th week	Overall	195^{b} ± 2.79	106^{a} ± 2.62	188^{b} ± 2.28	241^{c} ± 2.96	240^{c} ± 2.61
5th week	Overall	279^{c} ± 2.93	126^{a} ± 2.73	247^{b} ± 2.40	337^{d} ± 3.08	338^{d} ± 2.72
6th week	Overall	346^{b} ± 6.64	212^{a} ± 6.19	356^{b} ± 5.45	443^{d} ± 6.97	412^{c} ± 6.16
7th week	Overall	435^{b} ± 7.07	249^{a} ± 6.58	419^{d} ± 5.88	529^{d} ± 7.37	477^{b} ± 6.55
8th week	Overall	505^{b} ± 4.69	276^{a} ±4.34	534^{c} ± 3.88	633^{d} ± 4.86	601.3^{d}±4.32
9th week	Overall	602^{b} ± 4.98	311^{a} ± 4.61	611^{b} ± 4.22	730^{d} ± 5.17	683^{c} ± 4.61
10th week	Overall	714^{c} ± 6.80	390^{a} ± 6.32	664^{b} ± 5.77	851^{e} ± 7.07	808^{d} ± 6.34
11th week	Overall	798^{c} ± 7.08	437^{a} ± 6.69	701.6^{b}±6.12	952^{d} ±7.36	926^{d} ± 6.69
12th week	Overall	921^{c} ± 6.00	520^{a} ± 5.66	763^{b} ± 5.18	1039^{e} ± 6.27	983^{d} ± 5.66
13th week	Overall	1021^{c}±6.22	575^{a} ± 5.87	820^{b} ± 5.39	1144^{d}±6.63	1007^{c} ± 5.87
14th week	Overall	1132^{d}±6.50	780^{a} ± 6.14	956^{d} ± 5.63	1222^{e}±6.93	1103^{c} ± 6.14
15th week	Overall	1236^{d}±6.17	790^{a} ± 6.11	1011^{b}±5.61	1284^{e}±6.90	1200^{c} ± 6.11
16th week	Overall	1373^{d}±9.20	829^{a} ± 9.85	1129^{b}±7.97	1305^{d} ± 9.81	1237^{c} ± 8.68
17th week	Overall	1463^{d}±9.76	882^{a} ± 9.21	1136^{b}±8.49	1429^{d}±10.41	1258^{c}±9.21
18th week	Overall	1580^{d}±10.60	988^{a} ±10.00	1167^{b}±9.22	1469^{c}±11.30	1332^{b}±10.00
19th week	Overall	1649^{d}±11.08	1060^{a}±11.86	1530^{c}±11.86	1540^{c}±11.81	1428^{b}±10.45
20th week	Overall	1753^{d}±13.6	1208^{a}±12.8	1624^{c} ± 11.8	1622^{c}±14.4	1452^{b}±14.26

Table-5 : Estimates of percent heterosis for body weights of various crossbred male & female chicken at different weeks of age.

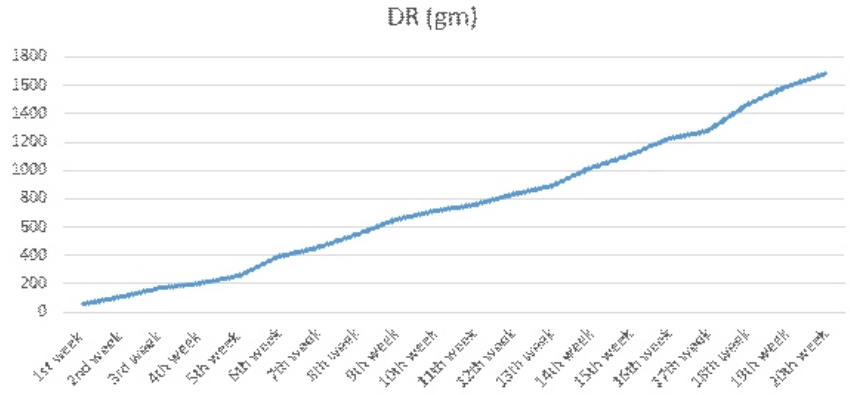
Age (week)	Male		Female	
	AS X DR	KN X DR	AS X DR	KN X DR
1st	29.47	14.89	30.09	56.9
2nd	13.78	86.50	22.60	35.56
3rd	14.29	43.79	22.82	60.30
4th	28.90	57.48	44.63	69.81
5th	26.58	75.55	29.6	87.31
6th	36.49	58.00	29.08	59.52
7th	22.53	39.17	28.12	56.90
8th	23.39	56.17	22.39	28.611
9th	17.34	44.48	20.66	52.48
10th	21.87	48.10	25.55	59.36
11th	24.44	57.48	28.93	68.72
12th	21.72	48.43	25.25	58.93
13th	20.85	39.56	25.90	48.54
14th	16.15	22.80	18.22	37.97
15th	11.85	29.94	15.10	37.53
16th	8.52	23.97	9.84	34.91
17th	9.62	19.80	8.47	20.65
18th	6.15	14.18	8.62	25.28
19th	3.03	12.91	8.89	21.04
20th	3.04	14.96	5.01	14.68

Present heterosis for body weight of crossbred female from 20th to 52nd weeks of age has been depicted in table below :

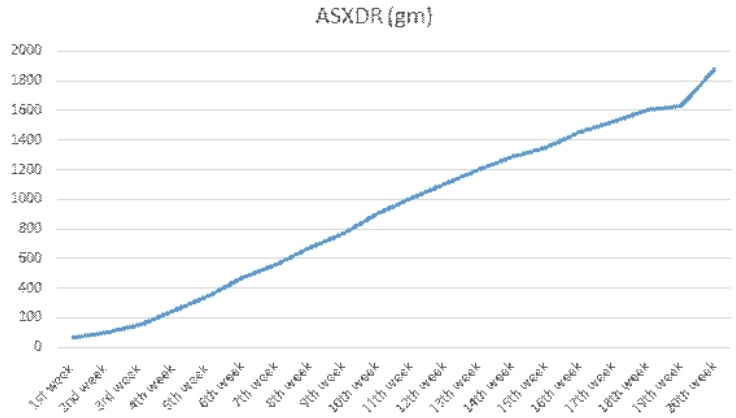
Table-6 : Percent heterosis for body weight of female only from 20 to 52 weeks of age.

Week	AS+DR/2	KN+DR/2	AS DR % Heterosis	KN DR % Heterosis
20th week	1484.5	1212.0	5.01	19.80
24th week	1518.0	1290.5	5.73	13.13
28th week	1559.0	1331.5	5.58	11.60
32th week	1607.5	1376.5	5.16	9.84
36th week	1642.0	1415.5	6.21	10.77
40th week	1681.0	1448.05	5.71	11.98
44th week	1709.0	1479.0	6.20	12.51
48th week	1738.5	1509.5	6.36	12.42
52nd week	1767.0	1546.5	6.56	11.99

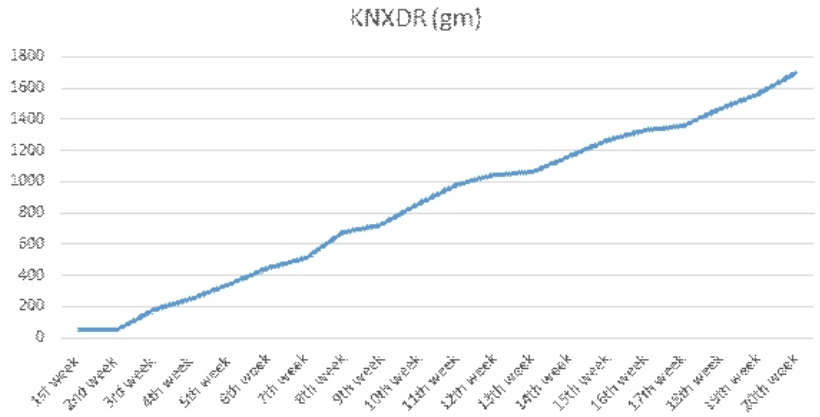
heavier than the Dahlem Red females at 11th week of age by 106 g. The lowest body weight was observed in both the sexes of Kadaknath (KN) than the counter parts of Aseel and Dahlem Red respectively at all ages of measurement. The average estimates of body weight of male of Aseel, Kadaknath and Dahlem Red at 12th week of age were 983.0 ± 7.01, 582.0 ± 6.62 and 826.0 ± 6.39 g respectively. At 16th week of age the respective body weights of male were 1501.0 ± 11.41, 979.0 ± 10.78 and 1283.0 ± 10.45 g respectively. Whereas, at 20th week of age the corresponding value were 1758.0± 15.90, 1225.0



Graph-1 : Trend in body weight of Dahlem Red (Male) from 1st to 20th week.



Graph-2 : Trend in body weight of Aseel x Dahlem Red (Male) from 1st to 20th week.



Graph-3 : Trend in body weight of KNxDR (Male) from 1st to 20th week.

± 15.0 and 1689.0 ± 14.50g respectively. At 20th week of age Aseel male were heavier in body weight than 12th week of age. The corresponding value for Kadaknath and Dahlem Red were 643.0g and 863.0 g respectively. The rate of growth of Aseel, Kadaknath and Dahlem Red male during the same period were 110.48, 78.84 and 104.48 percent respectively. Aseel, Kadaknath and Dahlem Red females at 12th week of age weighted 859.0 ± 6.12, 458.0 ± 5.91 and 701.0 ± 5.24g respectively. The corresponding value at 16th week of age were 1280 ± 9.39, 737.0 ± 9.06 and 1036.0 ± 8.08g respectively and at 20th week of age were 1549.0 ± 13.8, 1004.0 ± 13.4 and 1420.0 ± 12.0g respectively.

Irrespective of sex, the overall least squares means of body weight of Aseel (AS), Kadaknath (KN), Dahlem Red (DR) and their crosses (AS x DR and KN x DR) from 0 to 20th weeks of age have been depicted in table 4.3. irrespective of sex. Among purebreds, Aseel recorded the highest body weight (1753. ± 13.6g) at 20th week of age, whereas Kadaknath showed the lowest body weight

(1208 ± 12.8g). Among the crossbreds, AS x DR was the heaviest, which attained the body weight of 1622.0 ± 14.40g at 20th week of age. The average body weight of Aseel x DR at 20th week of age was significantly (p=0.05) heavier than KN x DR by 170g at 20th week of age. At 16th week of age the average body weight of Aseel, Kadaknath, Dahlem Red, AS x DR and KN x DR irrespective of sex were 1373 ± 9.20, 829.0 ± 9.85, 1129 ± 7.97, 1305 ± 9.81 and 1237.0 ± 8.68g respectively. Dahlem Red attained 1624.0± 11.8g body weight at 20th week of age, which was higher than the body weight reported by (3,4).

Heterosis for body weight : Heterosis percentage for body weight of male and female crossbred estimated based on mid parent value have been presented in table 4.6 from 1st to 20th week of ages.

It was recorded from table 4.6 that percent heterosis were higher in magnitude during early phase of growth from 1st to 15th week of age, there by started declining with the advancement of age in both the sexes and in all the genetic groups. However, present heterosis were found to be higher in KN x DR than Aseel x Dahlem Red chicken. Estimates of heterosis percentage were positive, which indicated that crossbreeding improves growth rate in the crossbred chicken. Improvement gradually decline since the bird's approaches sexual maturity. (5) reported positive heterosis for body weight at 20th week of age and negative heterosis as 40th week of age. (6) have reported positive heterosis for body weight (6,7). In contrary to the, negative heterosis percentages have been reported by (6,8,9).

Conclusions

The crosses of pure breeds of Kadaknath and Aseel with exotic Dahlem Red may be recommended for more yield of meat, eggs, eggshell quality, egg contents, carcass quality and FCR apart from these it was economical in overall performances of chickens. Eggs produced by the cross breeds were also found significantly heavier than the eggs produced by indigenous breeds, but significantly (P<0.05) lighter than the eggs produced by Dahlem Red. ASxDR may be recommended for the egg purpose, whereas KNxDR for the meat purpose in the backyard system of poultry rearing.

Acknowledgement

The authors are thankful to Vice-chancellor, BASU, Patna for encouragement, support and financial assistance provided for the study.

References

1. Mekky S.S., Galal A., Zaky H.I. and Zein-EI-Dein A. (2008). Diallel crossing analysis for body weight and egg production traits of two native Egyptian and two exotic chicken breeds. Intl. *J. Poult. Sci.* 7: 64-71.
2. Williams S.M., S.E. Price and P.B. Siegel (2002). Heterosis of growth and reproductive traits in fowl. *Poult. Sci.*, 81: 1109-1112.
3. Sharma L. (2000). Genetic studies on some economic traits and construction of multitrait selection indices in White Leghorn. *Thesis, M.Sc. Ag., G.B. Pant University of Agriculture and Technology.*
4. Kalita N. and Talukdar A. (2022). A study on the performance of the Dahlem red breed of chicken under intensive system of management in Assam. *The Pharma Innovation Journal*; SP-11(7): 4549-4550.
5. Laxmi P.J., Gupta B.R., Chatterjee R.N. and Reddy V.R. (2009). Combining ability analysis for certain economic traits in White Leghorn. *Indian J. Anim. Sci.* 51: 336-343.
6. Padhi M.K., Senani S., Ahlawat S.P.S., Saha S.K., Kundu A. and Chatterjee R.N. (2000). Fertility and hatchability performance of different breeds of chicken and crossbreds in hot and humid climate of A & N islands. *In: XX Annual conference and symposium of Indian Poultry Science Association.* October, 12-14.
7. Deepshikha Sharma and Archana Vaishnava (2023). In vitro shoot regeneration of *Elaeocarpus sphaericus* (Rudraksha) – An important medicinal plant. *Frontiers in Crop Improvement*, 11(1): 51-54.
8. Rao G.V. and Thomas P.C. (1984). The breed characteristics of Kadaknath breed of indigenous (Desi) chicken; *Avian Research.*, 68: 55-57.
9. Thakur M.S., Parmar S.N.S. and Pillai P.V.A. (2006). Studies on growth performance in Kadaknath breed of poultry; *Livestock Research for Rural Development*. 18: 1–9. http://www.cipav.org.co/lrrd/lrrd18/8/thak18116.htm