Production Performance of Reciprocal Cross between IPB D2 and IPB D3 Chickens from 1 to 12 Weeks of Age Reared in the Tropics

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ABSTRACT

At present, several local chicken breeds in Indonesia exhibit suboptimal production performance despite their goood adaptability to tropical conditions. A reciprocal cross between IPB D2 chickens and IPB D3 chickens was carried out, resulting in IPB D2D3 and IPB D3D2 chickens. This study aimed to observe the effects of crossbreeding on the production performance of these crossbred chickens in tropical regions. A total number of 27 IPB D2D3 and 48 IPB D3D2 crossbred chickens was used. All data were presented by descriptive statistics (mean, SD, CV) and analyzed by inferential statistics (two-sample t-test and Mann-Whitney U test) to determine differences between two types of crossbreds. The two-sample t-test was applied for body weight and body weight gain of chickens aged 5 to 12 weeks. Meanwhile, the nonparametric Mann-Whitney U test was used for feed intake and body weight gain in chickens aged 1 to 4 weeks. The results showed that at 12 weeks, the body weight of IPB D2D3 reached 1104.22 g for males and 975.55 g for females, while the body weight of IPB D3D2 reached 1090.39 g for males and 959.64 g for females. Better feed intake and feed conversion were achieved by IPB D2D3 males and IPB D3D2 females.

Keywords: IPB D2 and D3 chickens, production performance, reciprocal cross, tropics

ABSTRAK

Saat ini, beberapa ayam lokal di Indonesia belum memiliki performa produksi yang optimal meskipun memiliki kemampuan adaptasi yang baik di daerah tropis. Persilangan resiprok antara ayam IPB D2 dengan ayam IPB D3 dan resiprokalnya dilakukan untuk menghasilkan ayam IPB D2D3 dan IPB D3D2. Penelitian ini bertujuan mengamati efek persilangan terhadap performa produksi ayam hasil persilangan yang dipelihara di lingkungan tropis. Sejumlah 27 ekor ayam IPB D2D3 dan 48 ekor ayam IPB D3D2 digunakan dalam penelitian ini. Seluruh data disajikan secara statistik deskriptif (dalam bentuk rataan, simpangan baku dan keragaman) dan dianalisis menggunakan statistik inferential (uji t and Mann-Whitney U) untuk menguji perbedaan antar dua jenis ayam silangan. Variabel bobot badan dan pertambahan bobot badan ayam persilangan umur 5-12 minggu dilakukan uji T. Sementara variabel konsumsi pakan dan pertambahan bobot badan ayam persilangan umur 1-4 minggu diuji non parametrik dengan Mann-Whitney U. Ayam jantan IPB D2D3 menghasilkan bobot badan akhir 1104.22 g dan betina 975.55 g, sedangkan ayam IPB D3D2 menghasilkan bobot badan akhir 1090.39 g untuk jantan dan betina 959.64 g. Konsumsi pakan dan konversi pakan terbaik ditunjukkan oleh ayam jantan IPBD2D3 dan ayam betina D3D2.

Kata kunci: Ayam IPB D2 dan D3, performa produksi, persilangan, resiprok, tropis

INTRODUCTION

Indonesia is rich with indigenous and local chicken breeds that have the potential to provide a sustainable source of animal protein. Local chicken breeds can adapt easily to various environmental conditions, particularly in humid tropics. At present, several local chicken breeds exhibit suboptimal production performance, particularly in growth rate, despite their genetic potential. Therefore, upgrading genetic quality through selective breeding and applying crossbreeding strategies using superior genetic resources offers potential to enhance growth performance while maintaining adaptation advantages.

IPB D1 chickens are a result of crossing several chicken breeds (pelung, sentul, kampung, and broiler parent stock). During their development, IPB D1 chickens were selected for specific characteristics, resulting in the emergence of IPB D2 and IPB D3 chickens. The IPB D2 chicken is the result of selective breeding focused on disease resistance traits, specifically Newcastle disease (ND) with immunocompetence indicators based on total IgY concentration and antibody titer (Lestari *et al.* 2022). On the other hand, the IPB D3 chicken is the result of selective breeding focused on growth rate efficiency, characterized by optimally increased body weight.

The multi-location trial sites for IPB D chickens are in Boyolali residence in Central Java and Sinar Harapan Farm (SHF) in Jampang Tengah, Sukabumi Regency. SHF has been raising IPB D1 chickens since 2015. The SHF is located in tropical conditions with high ambient temperature and humidity. Raising poultry in hot and humid tropical climates commonly faces challenges such as heat stress and increased disease (Oke *et al.* 2021). Therefore, improving the chickens' environmental adaptiveness through genetic enhancement via crossbreeding is an option. According to Lapihu *et al.* (2019), crossbreeding leads to beneficial heterosis effects, such as increased body weight compared to their parents.

For this reason, the present study is necessary to obtain optimized individual variation of the crossbred by utilizing the genetic advantages of both breeds. To date, there has been limited information regarding the production performance of reciprocal crossbreeding between IPB D2 and IPB D3 chickens in a tropical farm site, which differ from the field laboratory environment at the IPB University. To address this, the study evaluated the adaptability and growth performance of the crossbred progeny (IPB D2D3 and IPB D3D2) raised under small-scale farm condition at SHF.

MATERIALS AND METHODS

The study was conducted at Sinar Harapan Farm, located in Panumbanan Village, Jampang Tengah, Sukabumi Regency, West Java for five month. In this study, a brooder cage sized 60 cm × 60 cm and a colony cage sized 100 cm × 60 cm were used. Other equipment included feeders, drinkers, wing bands, numbered rings, a digital scale, bulbs, a digital thermo-hygrometer, and an incubator. The experimental materials were day-old chicks from crossbreeds of IPB D2D3 and IPB D3D2, with 27 and 48 chicks, respectively. The other materials used were disinfectant, feed, ND vaccine, vitamin supplements, and medicine.

Matings were performed naturally by crossing female lines and male lines of both chicken breeds (IPB D2 and IPB D3) at a ratio of 1:5. A total of 3 female-line birds and 15 male-line birds from both chicken breeds were used in the crossing activities. The crossing model is illustrated in Figure 1. Eggs were collected in the afternoon for 5 days, and then incubated using an egg incubator. This process was repeated 3 times. The result day-old chicks are weighed and then numbered with rings for identification purposes.

The rearing of crossbred chickens from 0 to 4 weeks of age (starter phase) was carried out in brooder cages equipped with heaters using light bulbs. At 4 weeks of age, crossbred chickens are sexed (male and female) for both types of chickens. The rearing of crossbred chickens at 4 to 12 weeks of age is done in colony cages with the cage temperature adjusted to the ambient conditions.

Chickens fed commercial feed Sinta GD-21 by PT Sinta Prima Feed mill. The ration contained 20% to 22% crude protein, 5% crude fat, 5% crude fiber, 12% moisture, 8% ash, 0.8% to 1.1% calcium, and 0.5% phosphorus. Feeding was provided twice daily at 7 g per bird in the first week, then increased by 7 g per bird every week (Habib *et al.* 2020). Water was *ad libitum*.

Figure 1. Illustration model of crossing IPB D2 dan IPB D3 chickens

Climatic factors were recorded three times per day, at 07:00, 12:00, and 16:00 (Western Indonesian Time, UTC+7). Temperature and humidity values were used to determine the THI (Temperature Humidity Index). The THI was calculated according to the equation proposed by Tao and Xin (2003), which is:

$$\text{THI} = 0.85\,T_{db} + 0.15\,T_{wb} \quad (1)$$

Where T_{db} is dry-bulb temperature (°C), T_{wb} is wet-bulb temperature (°C).

The chicken body weight and the feed rest were measured weekly until 12 weeks of age. The variables observed in this study encompassed body weight, weight gain, feed intake, feed conversion, and mortality. The variable was measured according to the formulas below.

$$\text{Weight gain (g bird}^{-1}) = \text{Body weight in that week} - \text{Body weight of the previous} \quad (2)$$

$$\text{Feed intake (g)} = \text{Feed offered} - \text{Feed rest} \quad (3)$$

$$\text{Feed conversion} = \frac{\text{Feed Intake}}{\text{Weight gain}} \quad (4)$$

$$\text{Mortality (\%)} = \frac{\text{Number of chicken mortality}}{\text{Number of initial population}} \times 100\% \quad (5)$$

Data Analysis

The data obtained in this study were analyzed by using two types of statistical analyses: descriptive and inferential statistics. Descriptive statistics were use to present the mean, standard deviation, and coefficient of variation. Inferential statistical analyses were conducted to determine differences between two types of crossbreds using statistical methods: the two-sample t-test or the nonparametric Mann-Whitney U test (if the data were not normally distributed). The two-sample t-test was used for body weight and body weight gain (5 to 12 weeks of age). Meanwhile, the nonparametric Mann-Whitney test was applied for feed intake and body weight gain (1 to 4 weeks of age).

RESULTS AND DISCUSSION

General Condition of the Research Location

Sinar Harapan Farm (SHF), an IPB D chicken breeding farm in Sukabumi Regency, is located at an altitude of 583 meters above sea level with temperatures ranging from 20.3 °C to 33.2 °C, humidity levels of 59% to 94.6%, and annual rainfall of 1.895 mm (BMKG 2024). These conditions indicate that the research site is a humid tropical region with relatively high temperatures and humidity levels because of high annual rainfall.

Measurements in the starter phase (temperature and humidity were controlled by artificial heating) showed morning temperatures and humidity levels at 32.4 °C and 58.7%, respectively; noon temperatures and humidity levels 34.50 °C and 56% accordingly, and afternoon temperatures and humidity levels 33.5 °C and 56.9%, respectively. The ideal temperature range during the brooding period is between 32 °C and 33 °C. These results indicated that the highest temperatures during the brooding period occurred at noon, suggesting that a brooder equipped with the heaters is still influenced by the surrounding environmental temperature.

THI (Temperature-Humidity Index) is a combination of temperature and relative humidity used as an indicator to determine, illustrate, and assess the level of heat stress experienced by chickens. Increases in ambient temperature and relative humidity lead to higher Temperature-Humidity Index (THI) values, which in turn elevate stress levels in chickens.

According to Qurniawan *et al.* (2016), the THI for broiler chickens is divided into three categories: high (29.65 to 29.90 °C), medium (28.43 to 29.11 °C), and low (<27.06 °C). Figure 2 shows the average THI values during 5 to 12 weeks of rearing. The THI in the morning remained constant at around 24.4 °C, indicating that the chickens were in their comfort zone. The average THI during midday indicates high heat stress, while the THI in the afternoon indicates low to moderate heat stress. Figure 2 shows that the THI during several weeks of rearing fluctuated in the midday and afternoon due to weather changes. Heat
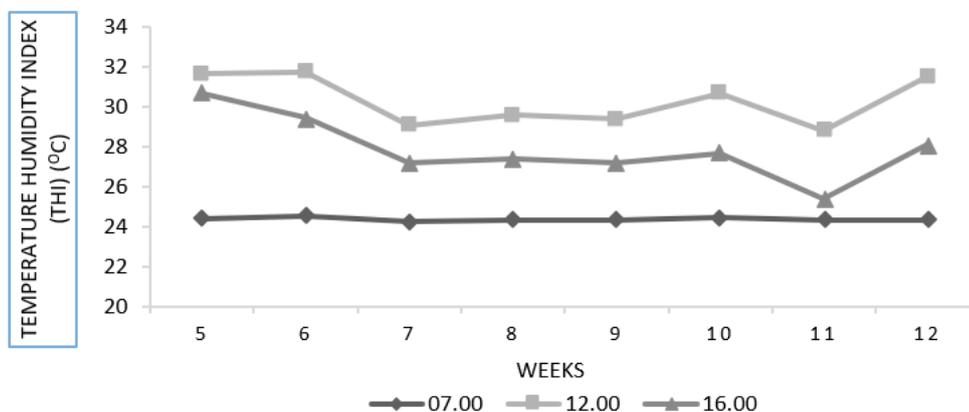

Figure 2. Graph of THI values during 5 to 12th week of rearing

stress conditions (high and moderate) indicated that the environment was unsuitable for the chickens and may disturb chicken productivity. During heat stress, chickens increased their breathing rate (panting) to dissipate body heat. Panting behavior causes blood flow and energy supply to prioritize respiratory organs, diverting blood flow away from other organs such as the digestive system, leading to decreased efficiency in digestion, metabolism, and feed conversion (Qurniawan *et al.* 2016).

Body Weight

At 4 weeks of age, chickens were sexed based on secondary sexual characteristics by the comb growth and body posture. Males exhibit larger combs and body postures than females. The body weight from 0 to 4 weeks was combined. Meanwhile, body weight at 5 weeks of age was based on sex.

The body weight of crossbred chickens from DOC to 4 weeks of age (Table 1) was not statistically significantly different (P>0.05). The body weight of IPB D3D2 DOC was higher than that of IPB D2D3. These result was influenced by the weight of hatching eggs, which had a positive correlation with the body weight of DOC. The hatching egg weight of IPB D2D3 and IPB D3D2 chickens was 44.90 g and 46.77 g, respectively. Hatching egg weight influences the body weight of DOC chickens by 91.8% (Rajab 2013). Research results by Ripaldi *et al.* (2023) showed that the body weight of DOC of local chickens was 28.35 g, which was lower than that of both types of crossbred. The coefficient of variance (CV) in early week was relatively high (>20%), indicating large variation among individual chickens. This was due to the low mean body weight and wide data distribution, which resulting in a high standard deviation. The CV calculation depends on the ratio between

the standard deviation and the mean; a standard deviation close to the mean will result in a high CV.

The male weight at 12 weeks of age reached a slaughter weight of 1 to 1,1 kg. The female weight of IPB D2D3 and IPB D3D2 at 12 weeks of age exhibited slaughter weights of 975.55 g and 959.64 g, respectively. The body weight of crossbred chickens did not differ (P>0.05) from 5 to 12 weeks of age in males and females (Table 1). As expected, the body weight of males was consistently higher than females in both crossbreeds.

Galib *et al.* (2024) reported that the weight of IPB D3 G4 chickens at 12 weeks of age reached 1021.44 g for males and 684.33 g for females. Table 1 shows that the body weight of crossbred chickens at 12 weeks of age was higher than that of one of their parents. This occurs due to the heterosis effect, which improves the genetics of crossbred chickens compared to their parents, through repeated crossbreeding and in-line selection (Link and Sauer 2016).

Weight Gain

Weight gain is strongly influenced by feed intake and nutritional content. Adequate feed intake of nutrients leads to higher weight gain. Optimal growth requires sufficient levels of protein and energy according to the age of the chickens. In this study, the feed used contained 20% to 22% protein and 4,099 kcal/kg energy (Mulyana *et al.* 2017). According to Nawawi and Nurrohmah (2011), kampung chickens required 19% to 20% protein with energy at 2,850 kcal per kg during the starter phase. Meanwhile, during the grower phase 18% to 19% protein and 2,900 kcal per kg energy were required.

Table 2 showed that the average weight gain in crossbred chicken was significantly different (P<0.05) at DOC-1 week and 4-5 week females. DOC to 4 weeks of age

Table 1. Body Weight of IPB D2D3 and IPB D3D2 Chickens from 1 to 12 Weeks of Age

Age (Week)	Mean ± sd (n;%CV) of Body Weight			
	IPB D2D3		IPB D3D2	
	g bird^{-1}			
DOC	29.00 ± 9.46 (27;32.62)		30.58 ± 3.68 (48;12.04)	
1	43.61 ± 24.41 (23;55.98)		47.91 ± 9.59 (45;20.01)	
2	83.00 ± 31.89 (23;38.43)		83.30 ± 19.67 (43;23.62)	
3	125.52 ± 45.94 (21;36.60)		131.16 ± 32.64 (43;24.89)	
4	186.90 ± 64.10 (21;34.29)		197.00 ± 40.99 (42;20.80)	
	Male		Female	
	IPB D2D3	IPB D3D2	IPB D2D3	IPB D3D2
5	248.33 ± 42.19 (9;16.99)	277.21 ± 60.91 (19;21.97)	253.17 ± 57.73 (12;22.80)	263.74 ± 42.25 (23;16.02)
6	329.78 ± 68.77 (9;20.85)	365.63 ± 80.89 (19;22.12)	317.67 ± 55.90 (12;17.80)	341.57 ± 50.56 (23;14.80)
7	410.33 ± 87.20 (9;21.25)	451.44 ± 97.08 (18;21.51)	399.25 ± 55.18 (12;13.82)	429.09 ± 70.51 (23;16.43)
8	517.22 ± 94.14 (9;18.20)	552.22 ± 111.93 (18;20.27)	499.00 ± 83.49 (11;16.73)	515.04 ± 81.61 (23;15.85)
9	660.44 ± 144.77 (9;17.38)	681.56 ± 128.52 (18;18.86)	614.55 ± 115.21 (11;18.75)	620.39 ± 115.51 (23;18.62)
10	823.67 ± 112.86 (9;13.70)	850.11 ± 159.22 (18;18.73)	745.45 ± 151.51 (11;20.32)	733.78 ± 127.54 (23;17.38)
11	987.00 ± 126.52 (9;12.94)	980.17 ± 180.47 (18;18.41)	877.55 ± 173.11 (11;19.73)	855.77 ± 133.25 (22;15.57)
12	1104.22 ± 157.05 (9;14.22)	1090.39 ± 206.93 (18;18.98)	975.55 ± 179.16 (11;18.37)	959.64 ± 148.17 (22;15.44)

Explanation: sd: standard deviation, CV: coefficient of variance, DOC: day-old chicks.

Table 2. Weight Gain of IPB D2D3 dan IPB D3D2 Chickens from 1 to 12 Weeks of Age

Weeks of Rearing	Mean ± sd (n;%CV) of Weight Gain			
	IPB D2D3		IPB D3D2	
	g bird^{-1}			
DOC–1	14.78 ± 5.83 (39.44)a		17.42 ± 6.60 (37.89)b	
1–2	39.39 ± 12.11 (30.74)		35.28 ± 13.52 (38.32)	
2–3	44.62 ± 12.72 (28.51)		47.86 ± 15.89 (33.21)	
3–4	61.38 ± 14.21 (23.15)		64.95 ± 16.70 (25.71)	
DOC–4	158.62 ± 36.68 (23.12)		166.60 ± 38.33 (23.01)	
	Male		Female	
	IPB D2D3	IPB D3D2	IPB D2D3	IPB D3D2
4–5	67.78 ± 10.71 (15.80)	79.84 ± 25.20 (31.57)	62.33 ± 18.41x (29.54)	97.43 ± 47.83y (49.09)
5–6	81.44 ± 33.31 (40.90)	88.42 ± 25.98 (29.38)	64.50 ± 18.22 (28.25)	77.83 ± 19.55 (25.12)
6–7	80.56 ± 28.35 (35.19)	81.56 ± 23.62 (28.97)	81.58 ± 22.22 (27.24)	87.52 ± 29.56 (33.77)
7–8	106.89 ± 24.39 (22.82)	100.78 ± 32.90 (32.64)	99.73 ± 32.56 (32.65)	85.96 ± 24.12 (28.06)
8–9	143.22 ± 24.73 (17.27)	129.33 ± 39.48 (30.52)	115.55 ± 45.16 (39.08)	105.35 ± 44.60 (42.34)
9–10	163.22 ± 36.34 (22.27)	168.56 ± 52.85 (31.35)	130.91 ± 51.67 (39.47)	113.39 ± 40.84 (36.02)
10–11	154.33 ± 32.62 (21.14)	130.06 ± 43.78 (33.66)	132.09 ± 43.97 (33.29)	112.95 ± 35.52 (31.44)
11–12	126.22 ± 45.90 (36.36)	110.22 ± 46.36 (42.06)	98.00 ± 21.79 (22.23)	103.86 ± 32.61 (31.39)
4–12	983.67 ± 133.57 (14.46)	891.39 ± 167.97 (18.84)	783.64 ± 150.93 (-19.26)	795.32 ± 143.93 (18.10)

sd: standard deviation, CV: coefficient of variance, DOC: day-old chicks. Values followed by different superscript letters (a and b for males, x and y for females) within the same row indicate significant differences (P<0.05).

in IPB D3D2 was higher than IPB D2D3. This phenomenon showed that IPB D3D2 was improved in the early phase of life after birth because maternal antibodies were transferred from the IPB D2 hen, which contains a high total IgY concentration of ≥10 mL (Cyrilla and Sumantri 2022). Antibodies from the mother (maternal antibodies) affect the immunity of chicks in egg yolks. Hens with high IgY (antibody) concentrations will produce egg yolks with high IgY as well (Sun *et al.* 2013).

The weight gain of crossbreds from 4 to 12 weeks of age showed that differed by sex: male IPB D2D3 gained 983.67 g, which was 9,8% higher compared to IPB D3D2 males (891.39 g). Meanwhile, female IPB D3D2 gained 795.32 g, about 1,5% higher than female IPB D2D3 (783.64 g). However, these differences were not significantly different P>0,05), possibly due to the small sample sizes (9-23 birds per group) and high(individual variation (14-19%). The numerical advantages of D2D3 males and D3D2 females may suggest sex-linked genetic interactions or differential maternal effects. Further studies with larger sample sizes would be needed to confirm these pattern.

The average daily gain (ADG) at 4-12 weeks of age in males was 17.57 g/day (D2D3) and 15.92 g/day (D3D2), while in females it was 13.99 g/day (D2D3) and 14.20 g/day (D3D2), which showed consistent values. That suggesting the both crossbreds as local chicken can adapt well to the small-scale farm environment.

The average weight gain from week 10 to 12 mostly decreased. Genetically, the growth pattern of IPB D2D3 and IPB D3D2 chickens was approximately that of native chickens, characterized by slow weight gain in the early phase, increased growth in the middle (rapid growth) phase, and slowdown again (growth inflection point) in the final phase (Habiburahman *et al.* 2018). On the other hand, enviromental conditions (Figure 2) showed that THI was lower until the 10-week experiment and increased at 12 weeks. These THI changes may disturb the chickens' homeostatic conditions leading to stress and decreased growth rate during the rapid growth phase.

Feed Intake

Optimal growth can be reached when chickens consume sufficient feed, both quality and quantity. Feed intake is influenced by body weight and size, sex, environmental conditions, production phase and the energy content. (Lokapirnasari 2017). During the starter phase (Table 3), IPB D2D3 exhibited significantly higher feed intake than IPB D3D2 at 2 and 3 weeks (P<0.05), though cumulative intake from 1-4 weeks of age was similar in both crossbreds. Generally, the chickens under 12 weeks of age use the feed for basic requirements and growth.

Feed intake of IPB D2D3 and IPB D3D2 at 9 and 12 weeks of age for males and 8 to 12 weeks of age for females (Table 3) was significantly different (P<0.05). The results showed that feed intake was positively corelated with age and body weight. The highest total feed intake during weeks 5-12 was observed in D2D3 males, which consumed 3,199.11 g. Males consumed more feed than females. Males were more active and had larger body sizes as well caused higher energy requirements than females.

Feed Conversion

Feed conversion ratio (FCR) indicates the efficiency of feed utilization for growth. FCR was influenced by genetics, feed nutrient content, feed form, environmental

Table 3. Feed Intake of IPB D2D3 dan IPB D3D2 Chickens from 1 to 12 Weeks of Age

Age (Weeks)	Mean ± sd (n;%CV) of Feed Intake			
	IPB D2D3		IPB D3D2	
	g bird⁻¹			
1	35.39 ± 0.21 (0.58)		34.80 ± 0.88 (2.53)	
2	75.80 ± 0.53 (0.70)a		76.82 ± 2.91 (3.78)b	
3	126.24 ± 0.60 (0.48)a		122.51 ± 4.16 (3.40)b	
4	169.95 ± 2.86 (1.69)		169.52 ± 1.91 (1.13)	
∑1–4	407.40 ± 2.12 (0.52)		403.62 ± 6.29 (1.56)	
	Male		Female	
	IPB D2D3	IPB D3D2	IPB D2D3	IPB D3D2
5	222.89 ± 0.42 (0.19)	225.26 ± 6.94 (3.08)	221.83 ± 0.89 (0.40)	222.61 ± 7.94 (3.57)
6	275.44 ± 3.54 (1.29)	275.91 ± 6.22 (2.26)	273.50 ± 2.61 (0.95)	273.26 ± 5.37 (1.96)
7	325.89 ± 0.04 (0.01)	329.14 ± 3.64 (1.11)	324.33 ± 8.38 (2.58)	323.48 ± 5.12 (1.58)
8	378.11 ± 3.04 (0.80)	328.05 ± 6.40 (1.68)	367.46 ± 13.21 (3.59)x	355.30 ± 7.93 (2.23)y
9	422.56 ± 3.21 (0.76)a	429.09 ± 2.46 (0.57)b	406.36 ± 17.07 (4.20)x	384.22 ± 21.74 (5.66)y
10	475.11 ± 9.79 (2.06)	478.32 ± 1.87 (0.39)	451.82 ± 27.84 (6.16)x	416.35 ± 15.18 (3.65)y
11	523.22 ± 8.71 (1.66)	526.32 ± 1.37 (0.26)	499.45 ± 20.06 (4.02)x	477.77 ± 11.77 (2.46)y
12	575.89 ± 14.2 (2.47)a	575.55 ± 2.33 (2.33)b	534.45 ± 17.15 (3.21)x	517.91 ± 15.25 (2.95)y
∑4-12	3199.11 ± 42.04 (1.31)	3221.65 ± 31.43 (0.98)	3079.91 ± 100.54 (3.26)	2927.61 ± 235.23 (8.03)

sd: standard deviation, CV: coefficient of variance. Values followed by different superscript letters (a and b for males, x and y for females) within the same row indicate significant differences (P < 0.05)

temperature, feed intake level, body weight, and sex (Listyasari *et al.* 2022). The lowest FCR indicates the most efficient of feed utilization for growth.

Table 4 shows the FCR of crossbred chickens at 1 to 4 weeks of age. IPB D3D2 exhibited lower FCR than IPB D2D3 chickens. It's because IPB D3D2 chickens had higher hatch weight, body weight, and weight gain. FCR during the brooding period was more efficient than during the grower period. This is partly due to the stable temperature in the brooding house, resulting in stable homeostatic conditions and thus more efficient FCR.

FCR values from weeks 5 to 12 showed that the most efficient FCR was male IPB D2D3 and female IPB D3D2. Feed conversion rates are inversely proportional to feed intake and correlate with body weight gain, with males showing more efficient conversion rates than females. Habiburahman (2018) reported that the average FCR of IPB D1 G4 chickens weeks 1 to 4 was 2.83, while chickens weeks 5 to 11 had FCR values was 3,88 for males and 4.84 for females. The crossbreds showed a better average FCR at the same age compared to their parent stock.

In weeks 11 and 12, feed conversion reached highest values compared to the previous week in both crossbreds, as feed intake increased while weight gain decreased. The birds reached their peak growth phase at 10 weeks of age, after which the ADG began to decline, led to a higher FCR and resulting in less efficient growth performance. These findings suggest that marketing at around 10 weeks of age (the growth inflection point) more profitable when evironmental conditions are unfavorable, or could be apply mitigation of heat stress through management practices (increased ventilation and air circulation, applying deseases

control, and inproved feeding management) can help maintain feed efficiency during final growth phase.

Mortality

Mortality is the rate at which chickens die during rearing. Table 5 shows the mortality rate. Mortality during the starter phase was not caused by disease, but due to improper housing management.

The mortality rate of chickens at 5 to 12 weeks of age was found to be highest in IPB D2D3 females. Although the crossbreds possessed adequate maternal IgY antibodies, they might still fail to resist the infections or parasites due to poor enviroment and severe exposure. Farm research was located in a hot-humid area, which is suitable for developing pathogenic agents to grow.

Field observation showed the chickens before death exhibited symptoms such as fever, watery and foamy eyes with swelled, which was suspected to be caused by snot disease caused by the bacterium Haemophilus paragallinarum, commonly occur during the transition from dry to rainy seasons (Moenek 2016). Additionally, there was chicken sign of emaciated body which noticeable hollow abdomen and dull feathers, indicating severe parasitic worm infection. The worm were commonly identified as Tetrameres spp. from the Nematoda class (Chandra *et al.* 2017).

In addition, the higher mortality rate in IPB D2D3 (25.93%) compared to IPB D3D2 (16.67%) indicates a potential economic losses. For a flock of 100 chicks, a mortality rate of 25.93% means approximately 26 birds are lost (assuming each bird could have reached around 0.9 kg at market weight). This corresponds in an estimated loss of

Table 4. Feed Conversion of IPB D2D3 dan IPB D3D2 Chickens from 1 to 12 Weeks of Age

Age (Weeks)	Feed Conversion					
	Male		Unsexed		Female	
	IPB D2D3	IPB D3D2	IPB D2D3	IPB D3D2	IPB D2D3	IPB D3D2
1			2.79	2.32		
2			2.17	2.73		
3			3.07	2.9		
4			2.93	2.78		
∑1–4			2.74	2.68		
5	3.36	3.14			3.84	2.9
6	4.21	3.57			4.59	3.86
7	4.42	4.45			4.43	4.21
8	3.72	4.02			4.19	4.7
9	3.04	3.68			4.11	4.3
10	3.1	3.13			4.64	4.15
11	3.54	4.46			4.56	5.36
12	5.32	6.17			5.77	5.41
∑5–12	3.84	4.08			4.52	4.36

Table 5. Mortality of IPB D2D3 dan IPB D3D2 Chickens from 1 to 12 Weeks of Age

Age (Weeks)	Crossbred Chickens	Sex	Initial Population	Mortality
			bird	% (bird)
0-4	IPB D2D3	Unsex	27	22 (6)
	IPB D3D2		48	12.5 (6)
5-Dec	IPB D2D3	Male	9	-
		Female	12	8.3 (1)
	IPB D3D2	Male	19	5.3 (1)
		Female	23	4.3 (1)

potential revenue of about Rp 1,404,000, based on current market prices of Rp 60,000/kg.

CONCLUSION

The reciprocal crossbred chickens between IPB D2 and IPB D3 chickens can reach a weight from 1.0 to 1.1 kg in males and 0.9 to 1.0 kg in females at 12 weeks of age. The peak growth occurred at around 10 weeks, suggesting marketing at this age would be more profitable. Among the two crossbreds, IPB D3D2 is recommended showed superior early growth, higher survival rate in starter phase, and better female feed efficiency. These advantages indicate can reduces economic losses and simplify management in small-scale tropical farming systems.

REFERENCES

BMKG (Badan Meteorologi, Klimatologi, dan Geofisika). 2024. Pengamatan unsur iklim menurut bulan di Stasiun Geofisika Palabuhanratu, Badan Meteorologi, Klimatologi dan Geofisika (BMKG) Stasiun Klimatologi Jawa Barat, 2023. https://sukabumikab.bps.go.id [23 Juli 2025].

Chandra, M., I. A. P. Apsarim, & N. Sulabda. 2017. Prevalensi dan intensitas infeksi cacing Tetrameres spp. pada ayam buras di wilayah bukit jimbaran, badung. IMV. 6(4):296-303. doi: https://doi.org/10.19087/imv.2017.6.4.296.

Galib, I., C. Sumantri, S. Darwati, & S. Murtini. 2024. Weight performance of 4th generation IPB D3 local chicken aged 1-3 months and it's heritability value. JIPTHP. 12(1):14-20. doi: https://doi.org/10.29244/jipthp.12.1.14-20.

Habib, M. F., S. Murtini, L. Cyrilla, I. I. Arief, R. Mutia, & C. Sumantri. 2020. Performa pertumbuhan ayam IPB D1 pada perlakuan pakan dan manajemen yang berbeda. J Agripet. 20(2):177-186.

Habiburahman, R., S. Darwati, & C. Sumantri. 2018. Pola pertumbuhan ayam silangan pelung sentul kanpung ras pedaging (IPB D1) G4 umur 1-12 minggu. JIPTHP. 6(3):81-89.

Iskandar, S. 2017. Petunjuk Teknis Produksi Ayam Lokal Pedaging Unggul. Pusat Penelitian dan Pengembangan Peternakan, Bogor.

Lapihu, Y. L., F. M. S. Telupere, & H. Sutedjo. 2019. Kajian fenotip dan genetik performa pertumbuhan dari persilangan ayam lokal dengan ayam ras petelur isa brown. JSPI. 14(3):298-305. doi: https://doi.org/10.31186/jspi.id.14.3.298-305.

Link, W. A., & J. R. Sauer. 2016. Bayesian cross-validation for model evaluation and selection with application to the North American Breeding Bird Survey. Ecology. 97(7):1746-1758. doi: 10.1890/15-1286.1.

Listyasari, N., Soeharsono, & M. T. E. Purnama. 2022. Peningkatan bobot badan, konsumsi dan konversi pakan dengan pengaturan komposisi seksing ayam broiler jantan dan betina. J Actavetindones. 10(3):275-280.

Lokapirnasari, P. W. 2017. Nutrisi dan Manajemen Pakan Burung Puyuh. Airlangga University Press, Surabaya.

Moenek, D. Y. J. A. 2016. Manajemen penyakit infectious coryza (snot). JP. 15(2):238-245. doi: http://dx.doi.org/10.35726/jp.v21i1.136.

Mulyana, A. A., D. Sudrajat, & Jatmiko. 2017. Pengaruh subtitusi pakan komersil oleh tepung bungkil inti sawit terhadap energi metabolis dan kecernaan ransum ayam kampung. Jurnal Pertanian. 8(1):1-6.

Nawawi, N. T., & Nurrohmah. 2011. Pakan Ayam Kampung. Penebar Swadaya, Jakarta.

Qurniawan, A., I. I. Arief, & R. Afnan. 2016. Performans produksi ayam pedaging pada lingkungan pemeliharaan dengan ketinggian yang berbeda di Sulawesi Selatan. J Vet. 1794):622-633. doi: http://dx.doi.org/10.19087/jveteriner.2016.17.4.622**.**

Rajab. 2013. Hubungan bobot telur dengan fertilitas, daya tetas, dan bobot anak ayam kampung. Jurnal Ilmu Ternak dan Tanaman. 3(2):56-60.

Ripaldi, M. Rusdin, & L. O. Nafiu. 2023. Fertilitas dan daya tetas telur ayam kampung dan pelung dari induk berbulu hitam dan berjengger tunggal. JIPHO. 5(2):174-177.

Sun, H., S. Chen, X. Cai, G. Xu, & Q. Lujiang. 2013. Correlation analysis of the total IgY level in hen serum, egg yolk and off spring serum. Journal of Animal Scince and Biotechnology. 4(1):10.

Tao, X., & H. Xin. 2003. Acute synergistic effect of air temperature, humidity, and velocity on homeostatis of market-size broilers. American Society of Agricultural Engineers. 46(2):491–497. doi: http://dx.doi.org/10.13031/2013.12971.