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PRODUCTION PERFORMANCE EVALUATION OF D-LINE THREE STRAINS GRANDPARENT STOCK OF BROILER CHICKEN IN INDONESIA

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Abstract
This study aims to evaluate the production performance of female line female (D-line) broiler breeders on three GPS strains of broiler chickens: S4, S3, and S2. Secondary audited data of production performance from 2017-2021, covering 70 flocks (19 S4 strains, 30 S3 strains and 21 S2 strains), were used in this study. The flocks were maintained in closed houses during the laying period, aged 25-65 weeks, across various regions in Indonesia. Parameters measured included livability during laying, egg production per hen house, peak production per hen house, hatching egg production (HE/hatching egg) per hen house, fertility, hatchability, and saleable chicks per hen house. Descriptive analysis and ANOVA were employed to compare performance between strains, and the performance of each strain against practical standards (principal standards) was analyzed descriptively and with a t-test. The three strains have distinct characteristics and advantages regarding in their production. The superior production performance of each strain was different to the practical standards (standard principal). The S4 strain performed the best or at par with the standard in viability, egg production, HE production, and fertility. The S3 strain excelled in fertility and hatchability, while the S2 strain demonstrated stable performance in fertility and hatchability. Significant differences ($P<0.01$) were observed in the production performance between the three strains. Moreover, each strain showed significant differences ($P<0.05$) or very significant differences ($P<0.01$) when compared to the principal standard. The actual average maintenance values in Indonesia were found to be quite good, aligning with practical/principal standards. In conclusion, the evaluation of the production performance of D-Line broiler breeder strains in Indonesia indicates satisfactory performance according to practical/principal standards. The results provide a reference for the government in determining the annual allocation for the import of GPS broiler chickens.
Key words: DOC grandparent stock, D-line, production performance, saleable chick, strain.

EVALUASI KINERJA PRODUKSI D LINE TIGA STRAIN GRAND PARENT STOCK AYAM RAS TIPE PEDAGING DI INDONESIA

Abstrak
Day old chick (DOC) Grand Parent Stock (GPS) ayam ras pedaging merupakan ayam ras hasil impor yang memiliki produktivitas cukup tinggi dan setiap tahun diimpor oleh pelaku usaha pembibit di Indonesia. Penelitian ini bertujuan untuk mengevaluasi kinerja produksi induk jalur female line female (Dline) pada tiga strain GPS ayam ras pedaging yaitu S4, S3, dan S2. Data yang digunakan merupakan data sekunder tahun 2017-2021 sebanyak 70 flock dengan rincian strain S4 19 flock, strain S3 30 flock, dan strain S2 21 flock. Data tersebut merupakan hasil audit performa produksi pelaku usaha pembibit GPS ayam ras pedaging yang tersebar di beberapa wilayah Indonesia dengan pemeliharaan pada closed house saat periode laying umur 25–65 minggu. Penelitian dilakukan dengan membandingkan performa antar strain (S4, S3, dan S2) dan membandingkan antara data aktual dengan standar praktisnya (principal standard). Parameter yang diukur yaitu; daya hidup masa laying, produksi telur per hen house, puncak produksi per hen house, produksi telur tetas (HE/hatching egg) per hen house, fertilitas, daya tetas, dan saleable chick per hen house. Data parameter dianalisis secara deskriptif serta analisis sidik ragam (ANOVA) yaitu performa antar strain, sedangkan performa tiap strain terhadap standar praktis/standar principal dianalisis secara deskriptif dan uji t. Ketiga strain memiliki karakteristik dan keunggulan terhadap masing-masing sifat produksinya. Keunggulan performa produksi setiap strain berbeda-beda yang mengacu pada standar praktis (standard principal). Berdasarkan standarnya masing-masing, strain S4 memiliki performa terbaik atau sama dengan standarnya pada sifat daya hidup, produksi telur, produksi HE, dan fertilitas. Strain S3 memiliki performa terbaik pada fertilitas dan daya tetas. Strain S2 memiliki performa yang sama atau stabil dengan standarnya pada sifat fertilitas dan daya tetas. Hasil penelitian terhadap performa produksi antar strain (3 strain) menunjukkan perbedaan yang sangat nyata ($P<0,01$) pada masing-masing strain. Tiap strain memiliki karakteristik masing-masing dan keunggulan yang berbeda antar ketiganya sehingga berbagai keunggulan dari ketiga strain tersebut dapat dikembangkan di Indonesia. Terdapat perbedaan yang nyata ($P<0,05$) serta sangat nyata ($P<0,01$) pada hasil uji performa produksi tiap strain terhadap standar principalnya, hal ini menujukkan bahwa tiap strain berbeda karateristik antara nilai aktualnya pada masing-masing standar yang diterapkan pada saat pemeliharaan di Indonesia. Standar praktis/principal merupakan acuan yang diharapkan tercapai oleh para pelaku usaha, dan ternyata berdasarkan hasil nilai aktual rata-rata pemeliharaan di Indonesia masih cukup baik. Berdasarkan hal tersebut diatas, hasil evaluasi kinerja produksi D-Line tiga strain grand parent stock ayam ras tipe pedaging di Indonesia memiliki kinerja yang cukup baik, sesuai terhadap standar praktis/principal, serta memiliki performa produksi saleable chick yang cukup baik dengan kisaran 44,20–57,58 ekor sebagai acuan pemerintah dalam menghitung alokasi jumlah impor GPS ayam ras tipe pedaging tiap tahunnya.
Kata kunci: DOC grandparent stock, D-line, kinerja produksi, saleable chick, strain.

INTRODUCTION

National broiler meat production exceeds the national demand, enabling exports to several countries in the form of hatching eggs (HE), day old chicks (DOC), consumer eggs, and other processed products. According to the Livestock and Animal Health Statistics data from the Directorate General of Livestock and

Animal Health, Ministry of Agriculture in 2022, the national production of DOC broiler chickens has reached 3.17 billion birds, equivalent to 3.6 million tons of purebred chicken meat.

The annual national demand for broiler meat continues to increase, growing from 3.04 million tons in 2021 to 3.21 million tons in 2022 (DGLAH, 2022). This increase is in line with the growing population and rising per capita consumption per year, which requires an increase in production quantities (DGLAH, 2022). To date, there are 14 (fourteen) old business actors and 8 (eight) new business actors who import DOC grandparent stock (GPS) broiler type chickens spread across Java, Sumatra and Kalimantan. The prospects for the purebred chicken industry are considered quite promising and have attracted the interest of purebred chicken breeders to move into the broiler type GPS industry (Ministry of Agriculture, 2023).

Domestically or imported broiler day old chick/hatching eggs (DOC/HE) play a very important role in meeting the demand of broiler breeds nationally. GPS broiler breeds still depend 100% on imported S4, S3, S2 and S strain breeds. If there is a shortage of PS domestically, only part of the broiler parent stock (PS) chickens will be imported, while the final stock (FS) broiler chickens are supplied from domestic production. The planned availability of broiler breeds will create a balance of breed supply and demand (DGLAH, 2018).

Until the 2020s, the government's allocation calculating for DOC from broiler chickens GPS did not consider the performance of each existing strain. Instead, the calculations were based on reports from each breeder, with a general calculation range of 1 GPS producing 35-40 PS and 1 PS produces 135-140 FS. As livestock performance improves across breeding companies, these calculations are subject to change.

The government is a regulator and facilitator in the availability of broiler breeds for the purebred chicken breeding industry. The government plays an important role in: (1) creating healthy competition among breeding companies in the domestic market; (2) development of a reporting system (distribution, production and disease); and (3) guarantee transparency DOC production information (GPS/PS/FS) as well as market conditions (demand, production and prices) (DGLAH, 2022).

The GPS breed chicken breeding industry faces high risks, therefore, it demands success as a guarantee of the availability of PS and FS breed chickens. GPS breeder chicken breeding companies must have good breeding management, biosecurity, business capital and business plans so that they can support the growth and development of the poultry industry (DGLAH, 2018).

In order to provide advice and input to the government and all relevant poultry stakeholders in calculating the production of GPS broiler type breeds of chickens in Indonesia, it is necessary to evaluate the production performance of D-line three GPS strains of broiler type breeds of chickens in Indonesia.

MATERIALS AND METHODS

Research was conducted in November 2022 – March 2023. The research took place at the Office of the Directorate of Animal Breeding and Production, Directorate General of Animal Husbandry and Animal Health, located at Jl. Harsono RM No. 3 Pasar Minggu District, South Jakarta. Secondary data used in this research were obtained from audit results of 10 business operators of GPS breeding companies for broiler breeds in 2017-2021. This study used general tools for recording/office activities, communication tools, and other supporting equipment.

This research evaluates the production performance of GPS broiler breeding companies during the laying period. According to Leeson and Summers (2009), the observations were focused on key production parameters for GPS broiler breeds, including egg production, size and weight of eggs, hatchability of fertile eggs, fertility, libido, sexual maturity, body maturity, vitality, aggressiveness, and adaptability to heat stress. This study focused on 7 production performance parameters for GPS breeding of broiler-type breeds during the laying period (25-65 weeks) cross three strains (refer to Table 1).

Table 1. Observational Variables Measured in this Research

Parameters	Description
Livability	Percentage of live D-line parental in the laying phase based on total chicken population after deducting depletion;
Egg Production	The numbers of egg produced per hen during 1 hen house period (25-65 weeks) in egg units;
Rate peak production/ hen house	Peak egg production rate during 1 henhouse period (25-65 weeks) in %. Generally, it is achieved at the age of 30 weeks;
Hatching egg production/Hen house	Total hatching egg production during 1 hen house period (25-65 weeks) is expressed in units of eggs;
Fertility	The percentage of eggs that have been fertilized or developed embryos among the total number of eggs that were incubated or hatched;
Hatchibilty	Percentage of the number of eggs hatched from the number of fertile eggs hatched. Egg hatchability is an indicator in determining the success of a hatchery; and
Saleable chick	The numbers of chicks produced from each GPS parent in DOC units

Data Collection

The data was drawn from 70 closed house breeding flocks, each with a minimum of 2 rearing cycles per flock and per breeding company. It included data from breeders of three strains: one S4 breeder (19 flocks), five S3 breeders (30 flocks), and six S2 breeders (21 flocks), located in several regions in Indonesia. In this study, some breeders maintained more than one strain, especially S3 and S2 strains. The average D-line population per flock in S2, S3 and S4 strain was 7,729 birds, 6,273 birds, and 27,056 birds, respectively.

Each breeding farms used standard closed house poultry houses design in a tunnel form, with dimensions of 12 m width and 120 m length, maintaining a density of 4.6 m^2. The cage floor included 1/3 litter made from sawdust and 2/3 slats. The collected data included information such as company name, province, district, flock identity, strain, age, parent population of line D (female line female), and other supporting data.

Performance comparison of broiler breed chickens was conducted for each strain (S4, S3, and S2), and the quality achievements of each strain were analyzed by comparative analysis of actual rearing data with the company's practical standards (principal standards).

Data Analysis

A comparative analysis on the production performance of each strain (S4, S3, and S2) was conducted using analysis of variance (ANOVA) with SPSS software (Armonk, NY: IBM Corp). Before analysis, normality testing was carried out. The statistical model applied was one-factor ANOVA expressed by the formula:

$$\mathbf{Yi= \mu+ \alpha_i + \varepsilon_i}$$

Information:

- Yi = performance variable analyzed in each flock;
- μ = population mean;
- α_i = fixed effect of i^{th} strain; and
- ε_i = treatment error.

Duncan's multiple comparison test was carried out if the parameter test results were significantly different at the 5% level. Comparison between actual and practical standards (principal standard) of production performance for each strain (S4, S3, and S2) was conducted using a one-sample T-test (Stanislaus 2009) with SPSS software (Armonk, NY: IBM Corp). If the data did not follow a normal distribution, the non-parametric Wilcoxon test was carried out (Stanislaus 2009).

RESULTS AND DISCUSSION

a. Productivity Variations between Strains S4, S3 and S2

The world production of broiler chicken breeds is currently produced by three large companies, namely Aviagen, Cobb-Vantress, and Hubbard (Hiemstra and Napel. 2013). In Indonesia, the distribution of GPS broiler chicken breeds includes four strains: S4, S3, S2, and S1. The performance of these strains differs from one another.

Table 2. Average production performance of three strains in Indonesia

Variable	S4	S3	S2
Liveability (%)	88,53±2,97^{A}	83,11±5,01^{B}	83,20±3,43^{B}
Egg production (egg /bird)	179,33±8,23^{A}	157,20±12,30^{B}	139,38±9,36^{C}
Peak Production (%)	83,15±4,09^{A}	81,64±2,29^{A}	75,14±4,94^{B}
Hatching Egg Production (HE) (egg / bird)	168,87±8,65^{A}	146,78±12,52^{B}	131,31±9,96^{C}
Fertility (%)	85,16±2,56^{B}	87,13±1,54^{A}	81,83±3,45^{C}
Hatchibility (%)	72,42±1,12^{B}	81,38±1,99^{A}	73,39±6,11^{B}
Saleable Chick (bird)	57,58±2,89^{A}	55,05±4,95^{A}	44,20±7,09^{B}

Description: Different superscript letters on the same row indicate highly significant differences ($P < 0.01$)

The averages of three GPS strains of broiler breed chickens (S4, S3, and S2) for seven production parameters is presented in Table 2. The results of the statistical analysis showed highly significant differences ($P<0.01$) among the three strains. These parameters are based on the results of GPS group tests for the 3 strains in 70 flocks during the laying period (25 – 65 weeks of age).

Table 2 reveals highly significant differences ($P<0.01$) in the performance of S4, S3, and S2 strains when reared in Indonesia. The S4 strain had higher production characteristics ($P<0.01$) compared to the S3 and S2 strains, especially in 5 out of the 7 observed parameters (livability, egg production, peak production, HE production, and saleable chicks). Strain S3 demonstrated higher production characteristics ($P<0.01$) than S2, especially in 4 parameters out of 7 parameters observed: peak production, fertility, hatchability, and saleable chicks. Strain S2 showed the lowest production performance ($P<0.01$) compared to the other two strains.

A comparison of production performance among the three strains in Indonesia, as presented in Table 2, highlights the S4 strain's superior performance in 5 production parameters. This is expected, given that the S4 strain is owned and maintained by a single breeding company in Indonesia. Consequently, with consistent management and standardized practices, uniform production performance is naturally achieved on each farm. This underscores that strains maintained by one breeder, even though they are in different regions, yield better results compared to strains maintained by multiple breeders, influenced by differing management practices and human resources.

The S3 and S2 strains had varying performance, because they were owned and maintained by multiple breeding companies, so their production performance results are not optimal. This is also a concern for the government and business actors in implementing Good Breeding Practices, especially human resources who run the livestock business in order to maximize the business pattern being run.

In Indonesia, a crucial aspect in calculating production performance is the saleable chicks produced. The average value of saleable chicks, indicated in Table 2, ranges from 44.20–57.58 PS, categorizing it in the good success category, especially within the purebred chicken breeding activities in Indonesia. This might be an important reference, considering government's previous calculation for GPS imports of broiler chickens each year was based on the assumption that 1 GPS bird would produce 35-40 PS heads. The current range of 44.20. –57.58 PS indicates the ongoing and widespread development of these 3 strains, consistently being the preferred choice imported annually by breeders in Indonesia. The selection of each strain by the breeders is based on their years of experience in maintaining a particular strain.

b. Actual Performance of GPS Production of Broiler Type Chickens Compared with Practical Standards for Each Strain

Practical standards for the production of GPS for broiler type chickens for each strain, referred to as practical standards, are guidelines for raising each strain to reach the targets set by each breeding company. The practical standard for each strain is a reference that has been set by each principal in their country of origin based on the 25% best performance average in the world.

Table 3. Comparison of practical and actual standard performance of strain S4

Variable	Standard	Actual Data (n=19)	Difference (%)
Livability (%)	89,00	88,53±2,97	-0,53
Egg production (egg / bird)	177,90	179,33±8,23	0,80
Peak Production (%)	85,10^{A}	83,15±4,09^{B}	-2,29
Hatching Egg Production (HE) (egg / bird)	162,60^{B}	168,87±8,65^{a}	3,86
Fertility (%)	85,80	85,16±2,56	-0,75
Hatchibility (%)	78,90^{A}	72,42±1,12^{B}	-8,21
Saleable Chick (bird)	62,00^{A}	57,58±2,89^{B}	-7,13

Description: n=number of flocks;
Different superscript letters in the same column indicate significant differences (P<0.05) and very significant differences (P<0.01) in the one-sample t test.

Tables 3, 4, and 5 present a comparative analysis between practical standard values and actual performance data for each strain. The percentage difference (%) is calculated by subtracting the actual value from the standard value, divided by the standard value, and then multiplied by 100%. Comparisons were made using one-sample t-test (Stanislaus 2009).

The S3 strain is the second most common strain (27%) in Indonesia. The performance of the S4 strain, based on the S4 standard (2019), are presented in Table 3. Across 19 flocks, survival rate, egg production and fertility of the S4 strain exceed or matched practical standards, with for egg production notable surpassing the standards by 0.80%. HE production was significantly higher (P<0.05) than the practical standard by 3.86%, while peak production was significantly (P<0.05) lower than the practical standard by -2.29 %. Hatchability and saleable chic performance were both significantly (P<0.01) lower than the practical standard, with differences of -8.21% and -7.13%, respectively.

GPS flocks from S4 strain exhibited higher egg production and HE production from the practical standard by 0.80% and 3.86%, respectively. This success reflects the efficacy of cage and flock management, with an orientation towards increasing egg production and HE production. However, aspects handled by the housing section, including vitality, peak production, and fertility, fell slightly below the standard by -0.53%, -2.29%, and 0.75%, respectively. This indicates that the housing section still had some shortcomings in these 3 aspects. To achieve the set standards, it is necessary to evaluate and add improvements to the current farm management.

Hatchability and saleability of chicks in the S4 strain showed significantly lower values than the standard. This could be caused by the lengthy travel and storage pattern for HE eggs, as S4 strain relies on a single hatchery concentrated in one area, while the PS breeding farms are distributed across different provinces. Additionally, the sales of chicks are strictly based on orders, leading to the accumulation of stored HE eggs during periods of low demand. The extended travel and storage times likely contribute to the decreased hatchability and saleability of chick.

Each production parameter has its own advantages and disadvantages, with overall performance being good enough, as advantages for specific parameters almost reached 4%, while declines below the standard remained under 9%. This signifies the success of breeding companies int implementing effective broiler GPS breeding patterns, albeit adapting from the conditions of their country of origin.

The performance of the S3 strain, as compared to the S3 standard (2019), is presented in Table 4. Across 21 flocks, the fertility and hatchability performance of the S3 strain showed results that were very significantly (P<0.01) higher than the practical standard, with difference of 3.36% and 3.80%. Other performance indicators such as viability, egg production, peak production, HE production, and saleable chicks were very significantly (P<0.01) lower than the practical standards, with differences ranging from -3.38% to -12.62%).

Table 4. Comparison of standard and actual performance of strain S3

Variable	Standard	Actual Data (n=30)	Difference (%)
Liveability (%)	89,00^{A}	83,11±5,01^{B}	-6,62
Egg production (egg / bird)	176,10^{A}	157,20±12,30^{B}	-10,73
Peak Production (%)	84,50^{A}	81,64±2,29^{B}	-3,38
Hatching Egg Production (HE) (egg / bird)	161,50^{A}	146,78±12,52^{B}	-9,11
Fertility (%)	84,30^{B}	87,13±1,54^{A}	3,36
Hatchibility (%)	78,40^{B}	81,38±1,99^{A}	3,80
Saleable Chick (bird)	63,00^{A}	55,05±4,95^{B}	-12,62

Description: n=number of flocks;
Different superscript letters in the same column indicate significant differences (P<0.05) and very significant differences (P<0.01) in the one-sample t test.

In terms of actual performance relative to the standard, the S3 strain exhibited higher hatchability and fertility (3.36% and 3.80% higher, respectively). This shows that the S3 strain is more adaptive to these important parameters in purebred chicken breeding. Other aspects of performances, including viability, egg production, peak production, HE production, and saleable chicks fell below the standard, with values ranging from -3.38% to -12.62%. This suggests that the performance is still not optimal, considering the number of breeders maintaining the S3 strain (5 breeders with 30 different flocks at rearing locations).

The variations in human resource management applied at each breeding company likely contribute to differences in production outcomes between breeders. Despite these variations, the S3 strain remains the largest strain population (53%) in Indonesia, with many business actors. This strain presents advantages in terms of quantity and breed availability for Indonesia compared to other strains. Given its high relevance and demand, the S3 strain holds potential for further development domestically.

The performances of S2 strain compared to the S2 standard (2021) are presented in Table 5. Across a total of 30 S2 strain flocks maintained in Indonesia, no production performance exceeds the practical standard, with difference between -0.69% to -9.43 %. Fertility performance and hatchability were found to be the same as the practical standards. Moreover, peak production and saleable chick performances were significantly lower (P<0.05), while the viability, egg production and HE production were very significantly (P<0.01) lower than the practical standards.

The S2 strain is the third most common strain (13%) in Indonesia. This strain has been developing for a long time and was circulating in Indonesia long before the emergence of the S4 and S3 strains. The S2 strain's performance is widely owned by breeding companies, especially old breeding companies with longer experience in maintaining it.

Despite falling below the standard, the S2 strain's performance is considered quite good, with differences below the standard remaining under 10% (from -0.69% difference in fertility to -9.43% in saleable chicks). Apart from that, the S2 strain is maintained by more breeders, specifically six breeders compared to the S3 strain, which is only maintained by five breeders. This suggests continuous demand for S2 strain among breeders, considering that breeders has longer history and experience with S2 strain compared to other strains

Table 5. Comparison of standard and actual performance of strain S2

Variable	Standard	Actual (n=21)	Difference (%)
Liveability (%)	89,00^{A}	83,20±3,43^{B}	-6,52
Egg production (item head^{-1})	150,20^{A}	139,38±9,36^{B}	-7,20
Peak Production (%)	78,00^{a}	75,14±4,94^{b}	-3,67
Hatching Egg Production (item head^{-1})	139,50^{A}	131,31±9,96^{B}	-5,87
Fertility (%)	82,40	81,83±3,45	-0,69
Hatchibility (%)	74,30	73,39±6,11	-1,22
Saleable Chick (bird)	48,80^{a}	44,20±7,09^{b}	-9,43

Description: n=number of flocks;
Different superscript letters in the same column indicate significant differences (P<0.05) and very significant differences (P<0.01) in the one-sample t test.

c. General GPS Performance of Broiler Type Chickens in Indonesia

The broiler chicken industry is an economic base that has high potential for increasing economic growth and broad employment opportunities. The poultry industry in Indonesia has developed since the 1970s when modern breeds of chicken were introduced by private companies, and by 2022, Indonesia should have produced more than 3 billion FS broiler chickens (DGLAH, 2022). The results of this chicken breed products contribute approximately 65% to the national meat's demand, which was initially met by beef (DGLAH, 2022). The performance of broiler chickens needs to be continuously supported to obtain optimal phenotypes so that business margins are maximized.

The performance of this breed of chicken is generally influenced by three main factors: genetics, the environment, and the interaction between the two. The broiler breed chicken breeding industry, both grandparent stock (GPS) and parent stock (PS), generally divides their business into two sectors: the rearing (farm) and hatching sectors (hatchery). There are differences in the breeding objectives of these two sectors, the rearing sector pays attention to characteristic factors such as viability, egg production, peak production, HE production and fertility, while the hatchery characteristics pay more attention to the percentage of hatchability and saleability of chicks. HE egg production and saleable chicks stand out as core variables in both sectors.

This study reveals that the average HE production performance and hatchability of GPS female line female (D-line) chickens reared in Indonesia are higher compared to those in Western Europe and America, while survival performance was lower than in Europe West, America, and Japan (Hocking and McCorquodale, 2008). This shows that Indonesia is more adaptive to HE production and hatchability, while the lower viability is suspected to be cue to the increased depletion in DOC and older chickens. High DOC depletion might be caused by the effects of long travel from the country of origin to the destination country, and the addition of high depletion due to pattern maintenance that influences success, including human resource capabilities.

d. Performance Comparison of Broiler Type Chicken Strains

The broiler type chicken strains in Indonesia that are most often developed by breeding companies were S4, S3, S2, and S1. The distinguishing characteristics are: growth speed, resistance to disease, adaptability to the environment, and meat quality (Tamalluddin, 2012). Comparison of performance on variant strains (Table 2) explains the genetic factors of each strain.

The S4 and S3 strains have advantages in several characteristics. The superiority of HE and saleable chick production ($P<0.01$) in S4 indicates the potential for high sales product quantity and increased profits for the company. The high fertility percentage, hatchability percentage, and saleable chicks ($P<0.01$) in the S3 strain indicate good strain quality in maintenance. Meanwhile, the S2 strain which had the lowest performance ($P<0.01$) indicated that this strain still did not show maximum potential as a breed strain. The superiority of genetic potential is of primary importance in the breeding division because it influences livestock production and health (Van Marle-Köster and Visser 2021). Breed source selection is a critical factor in order to display an optimal phenotype for rearing (Strandén et al. 2019). The efficiency and viability of S2 strain in this study were lower than S3 and S4 strains are consistent with findings from the previous studies (Ulmer-Franco et al. 2010; Al-Bahouh et al. 2012). Previous studies have also highlighted the superior HE production characteristics and survival of strain S4 ($P<0.01$) compared to strain S3 (Zahid and Hussain 2002; Al-Dawood and Al-Atiyat 2022).

e. Factors for Broiler Type Chicken Breeding Companies and Maintenance Management

Poultry production is a global activity, with different management strategies adapted to local conditions worldwide. Achieving the genetic potential of purebred chickens depends primarily on environmental management, proper ration nutrition and effective disease control. Any suboptimal elements within these factors can compromise the performance (Schou et al., 2020). Environmental conditions, particularly those inducing heat stress, can disrupt the comfort, production and the welfare of poultry (Tamzil et al. 2013; Tamzil et al.

2014) and mammals (Suhendro et al. 2021; Suhendro et al. 2022). Optimal environmental factors should be uniform to ensure the clear expression of genetic differences without bias (Sun et al. 2019).

As the chickens were raised with relatively uniform environmental input, the phenotype in the GPS performance of broiler type chickens should be uniform as shown in the S4 strain. However the S3 strain and S2 strain have different performances in each breeding company and in different locations. This suggests that the S4 strain maintains stable performance even in diverse locations. The differences in performance provide valuable insights for managerial evaluation, especially the distinctions in human resources across breeding companies and original locations, as genetic performance will be expressed optimally if supported with an appropriate environment.

Management evaluation is crucial, especially the technical managerial ability to produce egg in breeding farms. The company manager is an indicator of how well business actors organize successful production and business activities (Heatubun et al., 2019). Kristianto et al. (2012) emphasizes that technology has an important role in increasing the quantity or volume of production in the production sector.

CONCLUSION

The evaluation of D-Line production performance from the grandparent stock of three broiler chicken strains in Indonesia reveals a satisfactory performance, aligned with each strains' practical/principal standards. These strains show satisfactory saleable chick production performance, ranging from 44.20 to 57.58 birds, providing a valuable reference for the government in calculating the import allocation of broiler chickens GPS each year.

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