Parameter Genetik:

(Estimasi Potensi dan Kualitas Genetik Ternak)

***Heritabilitas (h^2):** Nilai Pemuliaan (NP):
Estimated Breeding Value (EBV):

****Ripitabilitas (r) : L1 , L2 , L3, L4**
Producing ability (MPPA)

Perbedaan:
-hubungan vertikal vs horisontal .
-Angka pewarisan vs angka pengulangan
-Dll.

Kata Kunci , Pemuliaan Ternak:
Variasi Performans, Seleksi, keunggulan genetik, sistem perkawinan, (inbred/outbreed, parameter genetik, korelasi, NP, MPPA, effek genetik/ efek heterosis.

Heritabilitas dan Nilai Pemuliaan

Pendahuluan:

Pewarisan Sifat
BERAPA BAGIAN DARI PERBEDAAN DIANTARA INDIVIDU AKAN DAPAT DIWARISKAN ?

P = G + E

Var P = Var G + Var E

Var G = penting, karena inilah yang akan diwariskan orang tua kepada keturunannnya.

Sifat Kuantitatif:
Aksi sejumlah besar gen (poligen)
Setiap gen mempunyai aksi berbeda (A, D, E)

Heritabilitas:

nilai 0 – 1 : rendah 0.0 - 0.2
sedang 0.2 – 0.4
tinggi > 0.4

Heritability is a population measure not a value associated with a single individual.

Heritability of a trait varies from one population to another and from environment to another.

Pengertian:

1. Berapa bagian dari var P total yang berasal dari pengaruh gen gen aditif
   h^2 = var A/ var P
2. Berapa bagian dari var individu dalam kelompok tetua terseleksi dapat diwariskan kepada keturunannya
3. Berapa besar ketepatan fenotipik untuk menduga nilai genetik
4. Regresi antara nilai genetik dan nilai fenotip

Heritability

1. Heritability in the broad sense (H^2): the proportion of the phenotypic variance that is due to genetic effects including additive, dominance and epistasis:

$$H^2 = \frac{V_G}{V_P} = \frac{V_A + V_D + V_I}{V_P}$$

- It measures the strength of the relationship between the phenotypic values for a trait and the genotypic values.

2. Heritability in the narrow sense (h^2):s the proportion of the phenotypic variance that is due to additive genetic effects only.

$$h^2 = \frac{V_A}{V_P} = \boxed{\frac{V_A}{V_A + V_D + V_I + V_{EP} + V_{ET}}}$$

What does the heritability in the narrow sense measure?

1. **The strength of the relationship between the phenotypic values and the breeding values for a trait in the population.** Therefore, it can be viewed as the coefficient of regression of the breeding value on the phenotypic value.
2. **It measures the degree to which the offspring resemble their parents in performance for a trait:**

- If a trait has a large heritability: animals with high performance for the trait will produce offspring with high performance.
- If a trait has a small heritability: performance records of parents reveal little information about the performance of their offspring.

- **Heritability is always positive ranging from 0 to 1.0.**
- **Traits with low heritability (*h^2* < 0.20):**
  - Reproduksi: days open calving interval, litter size, and conception rate
  - Produksi:longevity or productive live (about 0.10)
  - Produksi: weaning weight in swine (about 0.10)
- **Moderately heritable traits (*h^2* of 0.2 to 0.4):**
  - Produksi:Milk yield, fat yield and protein yield (0.25-0.35)
  - Produksi:Birth weight in sheep
  - Produksi:Yearling weight in sheep
- **Highly heritable traits (*h^2> 0.4*):**
  - Kualitas Karkas: Carcass traits and traits related to skeletal dimensions like mature body weight
  - Kadar Lemak-Protein: Fat and protein% in milk.

Beef cattle	h^2
birth weight	.35
weaning weight	.30
weaning score	.25
feedlot gain	.45
carcass grade	.40
fat thickness	.33
rib eye area	.58
marbling	.42
retail product %	.30
calving interval	.08
conception rate	.05

Dairy cattle	h^2
milk yield	.25
fat yield	.25
solids-not-fat yield	.25
protein yield	.25
fat %	.50
solids-not-fat %	.50
protein %	.50
type score	.30

Layers		h^2
	chick livability	.05
	adult livability	.10
	body depth	.25
	adult body weight	.55
	egg production	.15
	egg weight	.55
	fertility	.05
Broilers		
	7-week weight	.45
	feed consumption	.70
	feed conversion	.35
	breast fleshing	.10
	fat deposition	.50

Sheep	h^2
90-day weight	.25
postweaning gain	.40
grease fleece wt	.35
fiber diameter	.40
staple length	.55
fat thickness	.30
loin eye area	.50
ewe fertility	.05
prolificacy	.10
lamb survival	.05
carcass weight	.35
dressing %	.10

Importance of heritability

1. **Heritability is important in selection:** The accuracy of selection is higher for a highly heritable trait than a low heritable trait. The larger the accuracy of selection, the larger is the expected response due to selection.

With selection based on phenotypic values:

- **Large *h2* ➔**high accuracy of selection (phenotypic value is a good indicator of breeding value)
- **Small *h2* ➔** low accuracy of selection (phenotypic value is not a good indicator of breeding value)

2. Heritability is important in prediction of breeding values and producing ability.

- Prediction of *BV* of animal *i* based on its phenotypic value, P_i ,is obtained as:

$$\widehat{BV}_i = h^2 (P_i - \overline{P})$$

3. Heritability is important in management:

- **Large h^2 ➔** genetic factors have important role as in growth traits (performance can be improved by selection).
- **Small h^2 ➔** environmental factors are important as in reproductive traits (selection is less effective and performance is improved mainly by improving the environmental effects such as improving nutrition and management practices).

Manfaat Nilai Heritabilitas

1. Menduga nilai pemuliaan

NP = **h2** (PI – Pp)

Pi performans individu

Pp rataan performans kelompok

2**. Mengetahui besarnya nilai Respon seleksi**

R = **h 2** . DS

= h2 (Xs – Xp)

Xs = rataan fenotip setelahh seleksi

Xp = rataan fenotip populasi

3. **Sebagai dasar pengembangan sebagian besar teori (model) penerapan pemuliaan ternak.**

Contoh (penggunaan h2)

Berat sapih (BS) sapi potong populasi : 120 ± 15 kg
(kisaran 105 - 135 kg)

Diseleksi (rataan seleksi) : 125 kg

Heritabilitas BS = 0. 48

Estimasi BS pada generasi N + 1 ????

1**. Untuk Seleksi:**

Pada GENERASI (N+ 1)

Differensial seleksi : (rataan terseleksi – rataan populasi)
(125 - 120)
= 5 kg

Respon seleksi : heritabilitas x diferential seleksi
0.48 x 5 = 2.4 kg

Estimasi Berat Sapih pada Generasi N + 1=
= 120 + 2.4 = 122.4 kg

2. Nilai Pemuliaan :

mis ada Individu Misalnya BS : 125 kg

NP = h2 (Pi-Pp) = 0.48 (125-120) = 0.48 x 5 = 2.5 kg

Breeding Value (BV)

- **The contribution of each effect is proportional to the variance explained by effect**

- **Concepts discussed on Phenotypic Selection still valid!!**

$$A = \frac{V_A}{V_P} P \qquad D = \frac{V_d}{V_P} P \qquad E = \frac{V_E}{V_P} P$$

Additive Effect or Breeding Value

Dominance

Environment

Estimated Breeding Value (EBV)

- **Notice that the Breeding Value of an animal is the sum of its genes Additive Effects**

- **Concepts discussed on Phenotypic Selection still valid!!**

$$\hat{A} = \frac{V_A}{V_P} P \qquad \overline{BV} = \frac{V_A}{V_P} P \qquad \Delta G = h^2 S$$

Additive Effect   Breeding Value   Genetic Gain

When estimated from Phenotypes   Phenot. Selection

Phenotype expressed as
a deviation from the mean

General Formulas for BV

$$BV = b(P - \overline{P})$$

- P = trait mean of the animal(s) of record.
- $\overline{P} =$ trait mean of contemporary group.
- b = regression factor.

$$\overline{BV} = \frac{V_A}{V_P} P$$

Phenotype expressed as a deviation from the mean

Estimated Breeding Value
x
Expected Progeny Difference

$$EPD = \frac{1}{2} EBV$$

- EPD = PTA = 1/2 EBV = the portion of an animal's BV that is expected to be passed on to its progeny for a given trait.

- An individual only transmits a sample composed of half of its genes to each of its offspring; this half is a random half of its genes.
- **Progeny difference (PD)** or **transmitting ability (TA)** are used in practice by some countries to rank animals.
- **PD = TA = ½ A**
- Progeny difference and transmitting ability are practical concepts. These are defined as the expected difference between the mean performance of the progeny of a parent and the mean performance of the progeny of all the parents in the population:
- $\boldsymbol{PD_i = TA_i = \mu_{\text{offspring of parent } i} - \mu_{\text{offspring of all parents}}}$

- Contoh Soal, if the estimated BV of a sire for weaning weight is + 2.5 kg and the estimated BV of the dam is + 1.5 kg, then the average expected BV of their offspring is equal to (2.5 + 1.5)/2= +2 kg.
- That is, we expect the average of offspring of these sire and dam to be 2 kg heavier at weaning than the average of all offspring in the population.

$$\bar{p}_{Offspring} = \mu + \bar{A}_{Offspring} = \mu + \frac{1}{2}A_{Sire} + \frac{1}{2}A_{Dam}$$

Therefore, if the population mean of weaning weight is 18 kg then the average phenotype of the offspring of these sire and dam is 18 + 2 = 20 kg.

- Progeny difference and transmitting ability are not directly measurable but can be predicted using performance data.
- The predicted value for PD is called EPD (expected progeny difference)
- The predicted value for TA is called PTA (predicted transmitting ability).
- Both terms mean the same thing but EPD is used in beef cattle, swine and sheep breeding while PTA is used in dairy cattle breeding.

Estimated Breeding Value
x
Expected Progeny Difference

$$EPD = \frac{1}{2} EBV$$

What is the expected average
Phenotype on the progeny
(change on the distribution mean)