Genetic parameters for larval body weight, development time and protein content in Hermetia illucens

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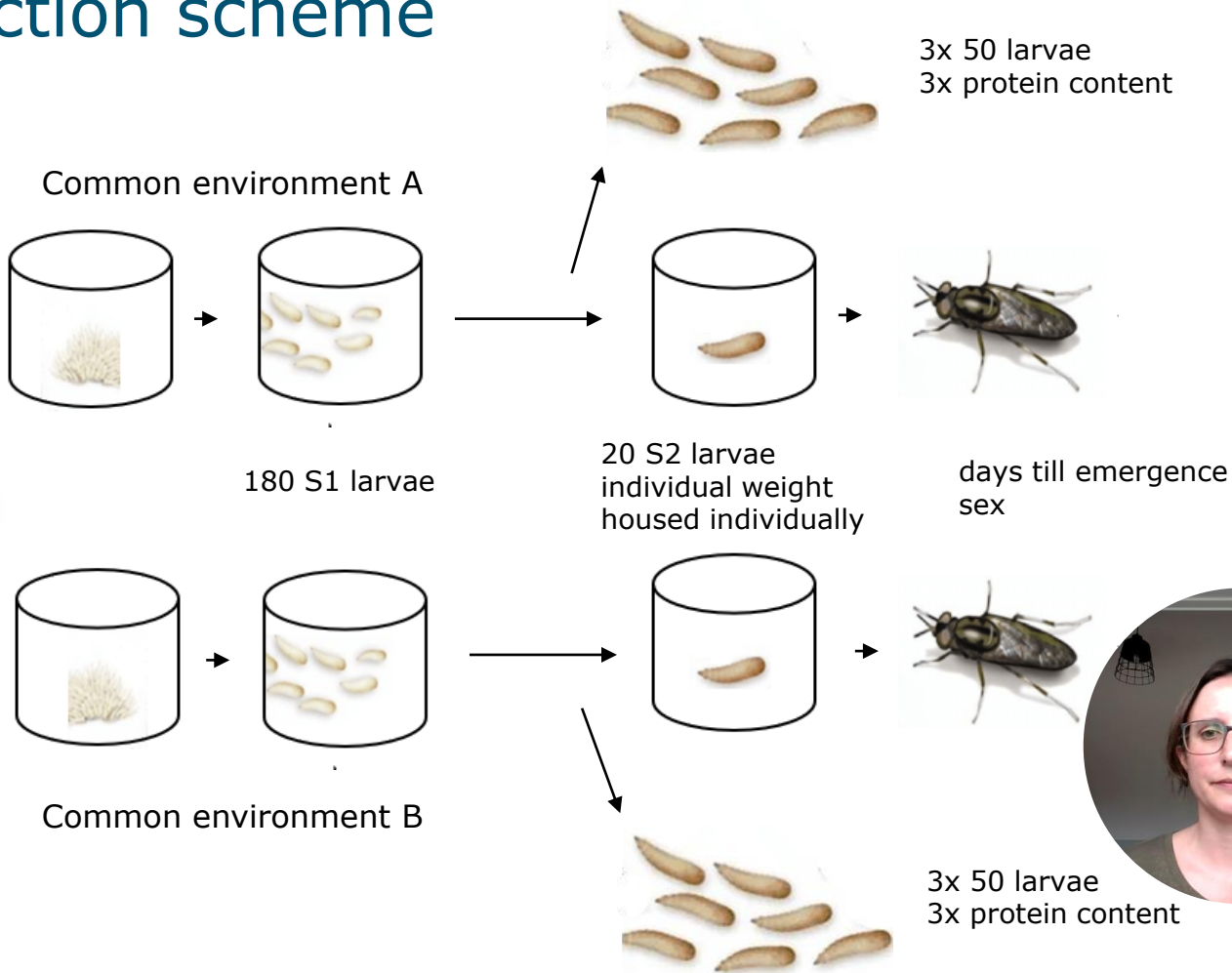
Background

- Upscale BSF production for aqua or animal feed

- Body weight is simple and heritable trait

- Composition of the product important

  - Difficult to measure

- Selection for production traits may have trade-offs

Estimate genetic parameters for body weight, protein content, development time in Indonesian strain of BSF

Data collection scheme

3x 50 larvae
3x protein content

Common environment A

180 S1 larvae

20 S2 larvae
individual weight
housed individually

days till emergence
sex

Common environment B

3x 50 larvae
3x protein content

3

Protein data

- Same 50 families

- From each FamEnv collected 3x50 larvae

- Protein measured on combined sample of 50 larvae

- Kjeldahl method

- 6 records per family; 3 per Family Environment

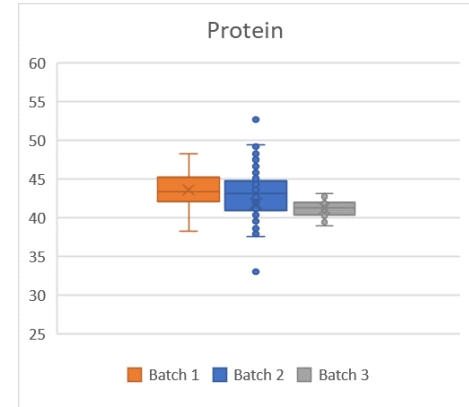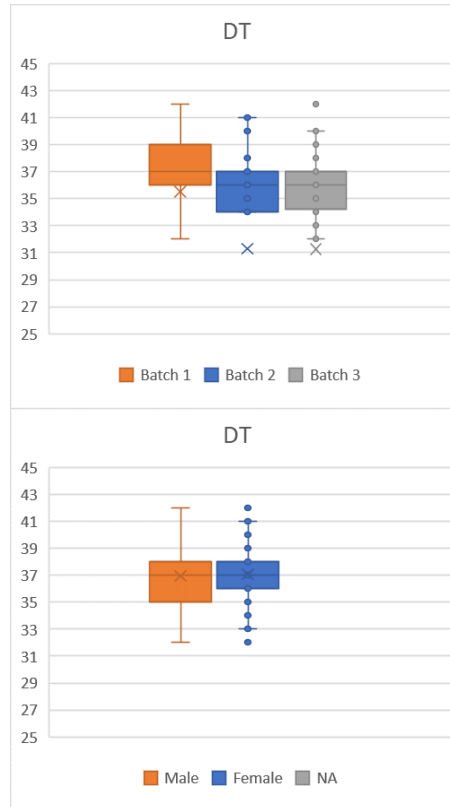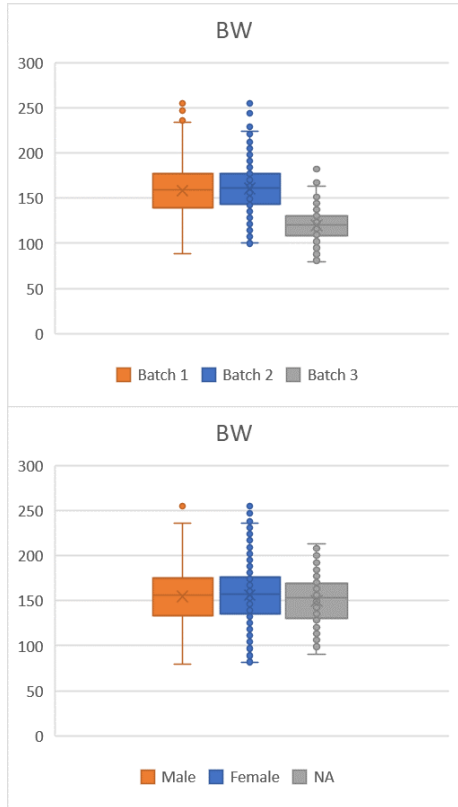- Full sibs of BW+DT individuals

Data collected

- 50 families; 40 larvae per family

- Each family split in 2 environments; 20 larvae per environment

- Done in 2 batches (2 days apart) + reserve families

	n	Measure on	#fam	mean	min	max
BW (mg)	2000	Individual	50	154.7	79.0	255.0
DT (d)	1791	Individual	50	37	32	42
Protein content	296	50 larvae	50	43.07	32.96	52.61

Batch and sex effects

ANOVA

y ~ batch + sex + Fam + Envir

BW	BW	DT	Protein	
Batch	< 2e-16	<2^e-16	<2^e-16	***
Sex	0.159	0.199	NA	
Fam	< 2e-16	1.95^e-07	<2^e-16	***
ENVIR	< 2e-16	3.38^e-10	2.94^e-13	***

Genetic analysis

- Linear mixed model to estimate variance components
- Y = mu + sex + batch + **family** + **environment** + e

- Full sib family structure: genetic variance is 2x family variance
- h^2 = genetic variance/total variance
- c^2 = common environmental variance/total variance

Genetic parameters

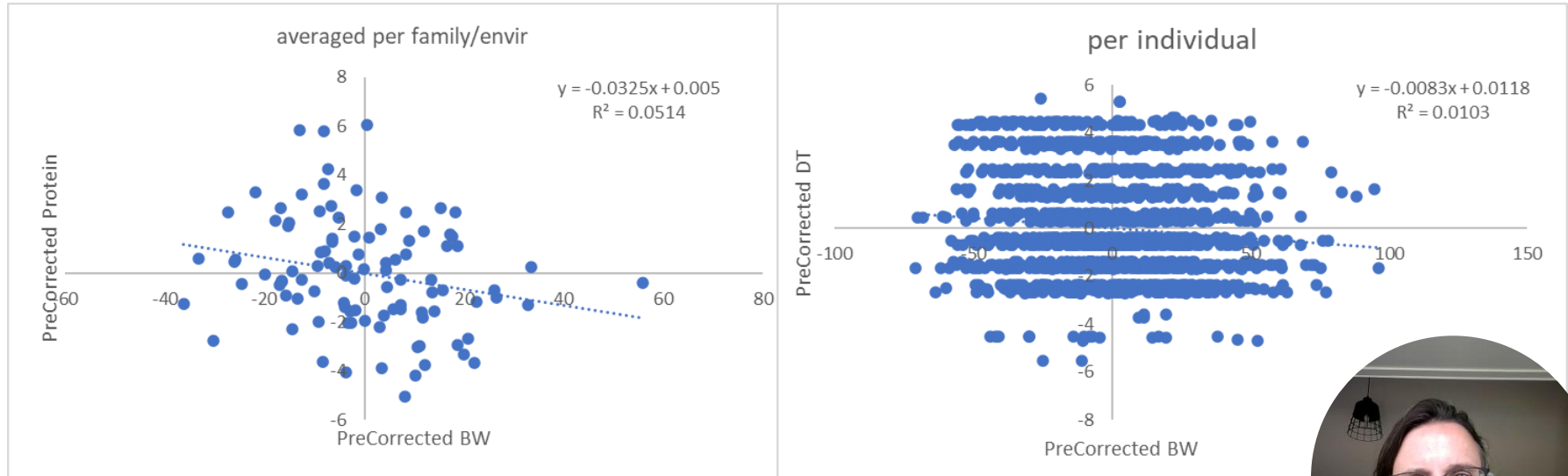|	h^2	c^2	σ^2_{fam}	σ^2_c	σ^2_e
BW	0.20 (0.11)	0.25 (0.05)	68 (38)	163 (37)	432 (14)
DT	0.00 (0.00)	0.09 (0.02)	0.00 (0.00)	0.37 (0.09)	4.03 (0.14)
Protein	0.94 (0.18)	0.27 (0.07)	2.94 (0.87)	1.71 (0.45)	1.60 (0.16)

Relation BW with protein and DT

Phenotypic correlation:

- BW-Protein: -0.23
- BW-DT: -0.10

Conclusion

Good opportunities for selection on body weight

Individual protein measures would improve estimates and enhance breeding opportunities

Phenotyping for breeding is a challenge!

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