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Genetic parameters for the oviposition time using high-throughput phenotyping from individual electronic nests in laying hens

Lorry Bécot, Nicolas Bédère, Jenna Coton, Thierry Burlot, Pascale Le Roy

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➤ Genetic parameters for the oviposition time using high-throughput phenotyping from individual electronic nests in laying hens

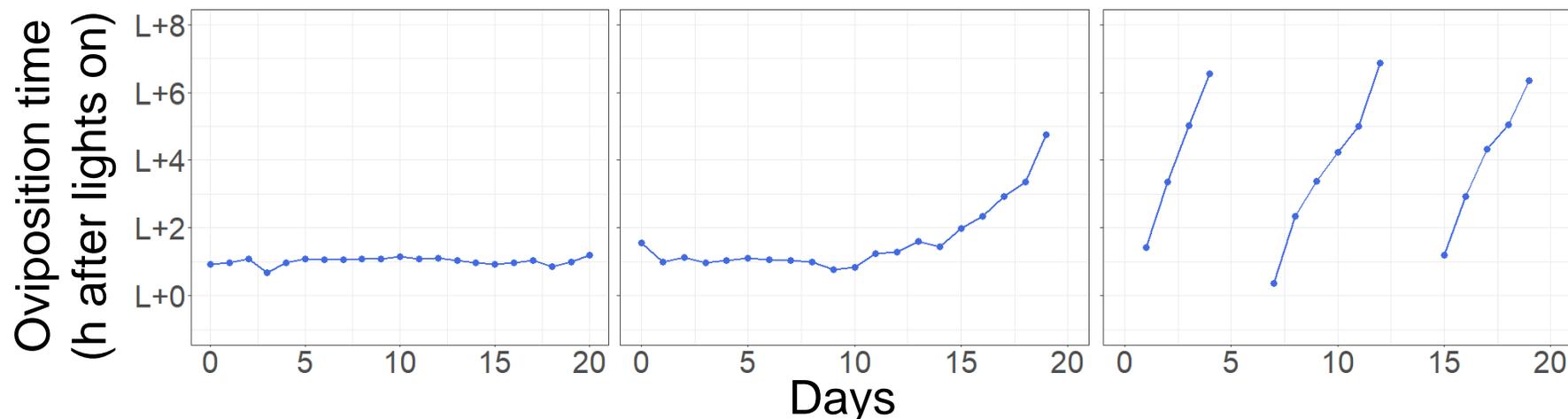
L. Bécot^{1,2}, N. Bédère², Jenna Coton¹, T. Burlot¹ and P. Le Roy²

¹NOVOGEN, 5 rue des Compagnons 22960 Plédran, France

²PEGASE, INRAE, Institut Agro, 16 Le Clos 35590 Saint-Gilles, France

➤ Oviposition time is an indicator of the laying rhythm

- Eggs are laid in sequences or clutches. Each clutch is separated by one or more days without lay.



- The length of the clutch is influenced by the drift in oviposition time (i.e. >24h between 2 consecutive oviposition), itself dependent on two cycles: photoperiod and follicle maturation.

→ Oviposition time is an indicator of the ovulation cycle and therefore of the laying rhythm

> Aim

- Little is known about the genetic background of oviposition time along the production
- The recent availability of individual electronic nest enables high-throughput phenotyping of nesting behavior, like the daily oviposition time

How use oviposition time for breeding selection?

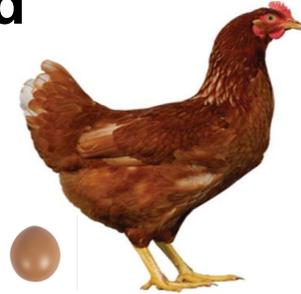
- Repeated records
- Summarized data

➤ Hens and breeding conditions

- 2 pure lines (Novogen)

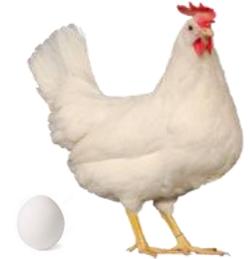
Rhode Island Red

- n = 1,180
- 144 sires and 495 dams
- 3 flocks (2017-2020)



White Leghorn

- n = 932
- 100 sires and 351 dams
- 2 flocks (2018-2020)



- Hens raised in floor pens with roosters
- Nests overlaid on two rows (≈ 1 nest for 5 hens)
- Lightning regime: 16 h of light – 8 h of darkness

➤ Data recorded with electronic nests

➤ Data recorded continuously between 24-64 wks. ≈ 220,000 oviposition in the nests by line

➤ Two data structures:

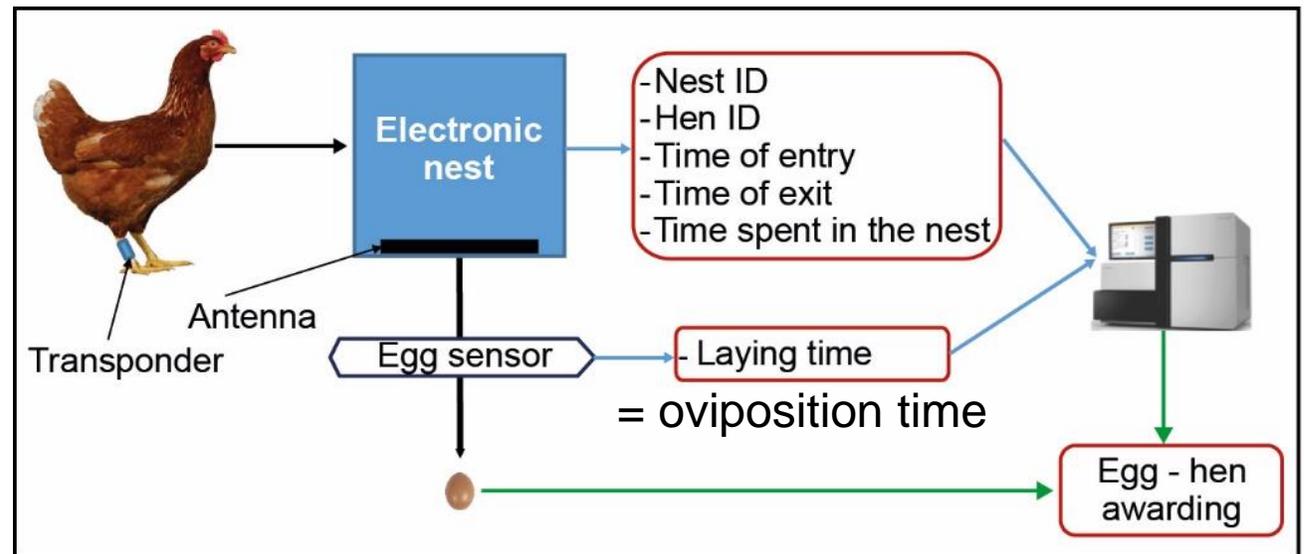
1) Ten 28-days periods

→ dynamic of oviposition time

2) Whole period

→ Relationships with summarized data

Principle of individual electronic nest



Bécot et al. 2021, INRAE Prod Anim.

➤ Traits and models

➤ Repeated trait

- Daily oviposition time



➤ Summarized traits (whole period only)

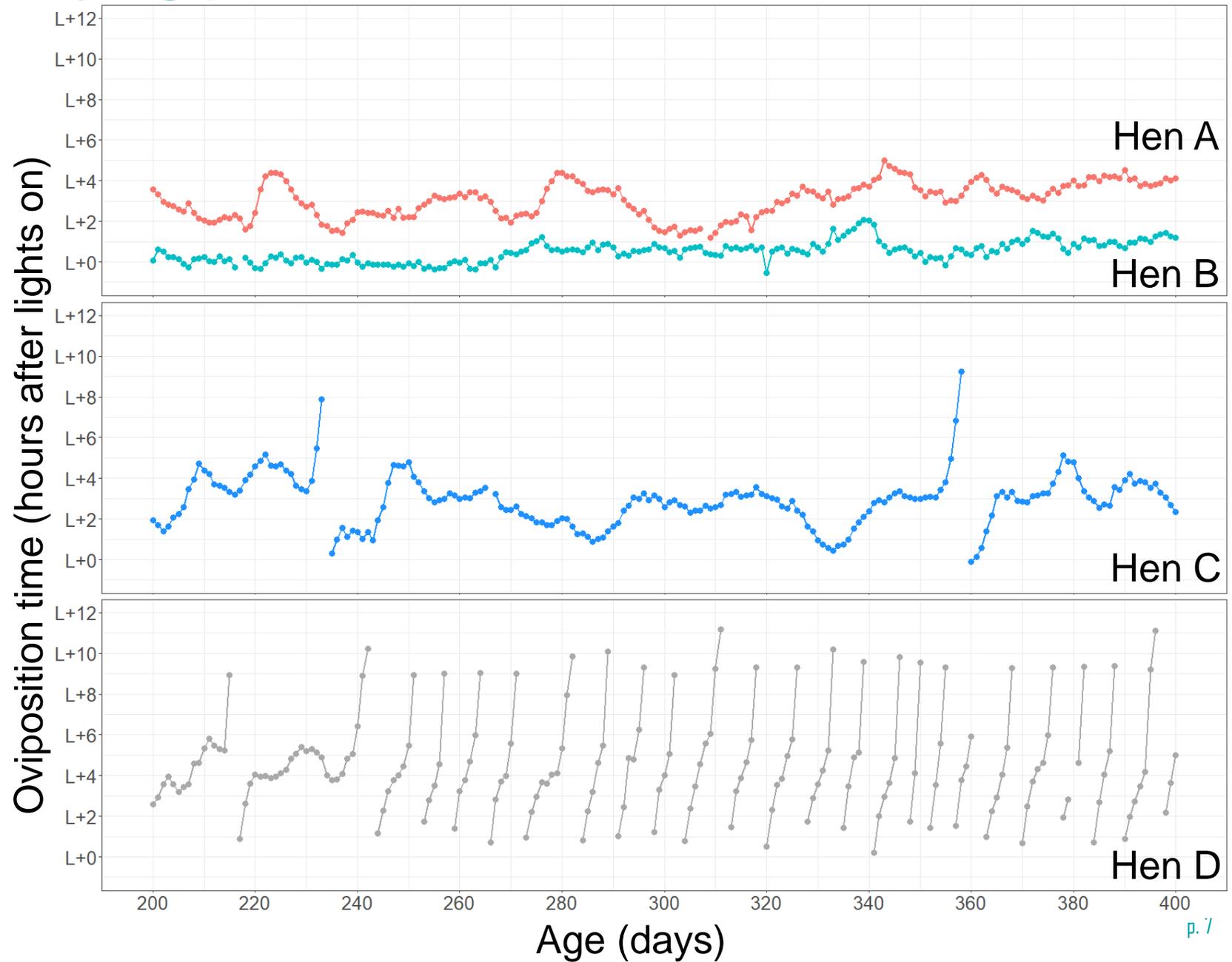
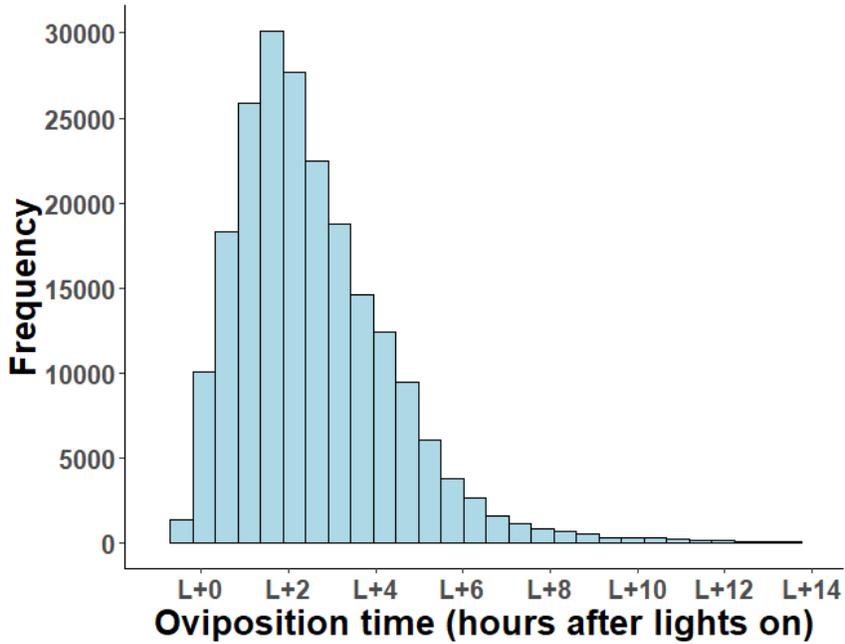
- Mean
- Variance ($\ln(\sigma^2)$)

➤ Environmental effects:

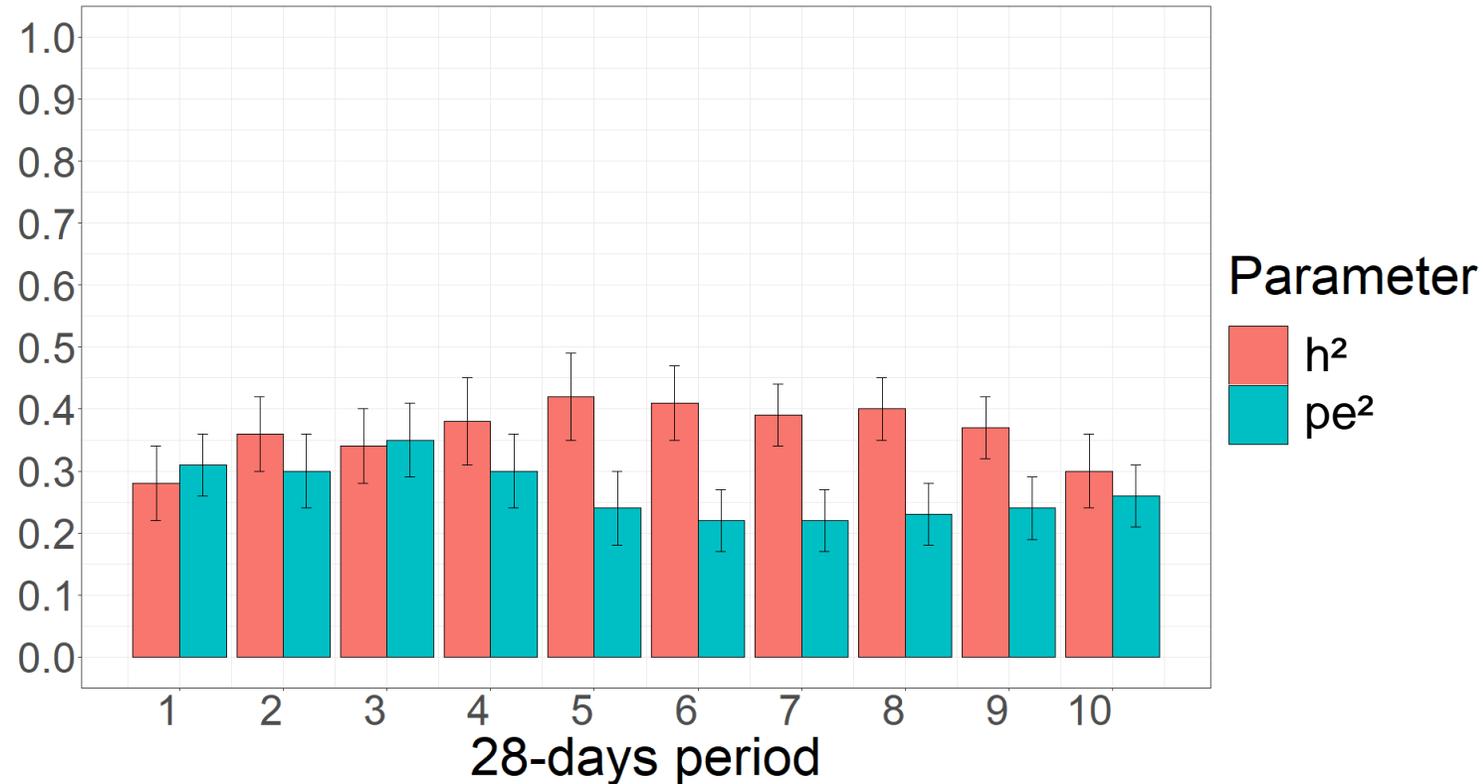
- Permanent environmental effect (repeated trait only)
- Fixed effect of the flock

➤ Animal model

➤ Large diversity of laying patterns in the nest



➤ Moderate heritability for daily oviposition time



➤ Heritability (h^2) ranging from 0.28 and 0.42

➤ Permanent environmental effect (pe^2) ranging from 0.22 and 0.35

} = repeatability

➤ Strong genetic correlations between 28-days periods

P1	0.97	0.93	0.87	0.87	0.86	0.85	0.80	0.82	0.87
	P2	0.96	0.91	0.89	0.90	0.86	0.77	0.84	0.83
		P3	0.98	0.94	0.95	0.95	0.90	0.94	0.88
			P4	0.97	0.98	0.97	0.92	0.94	0.92
				P5	0.99	0.98	0.94	0.98	0.95
					P6	0.99	0.97	0.97	0.94
						P7	0.97	0.98	0.96
							P8	0.99	0.98
								P9	0.98
									P10

➤ $r_g \geq +0.77$ (mean s.e. = 0.02)

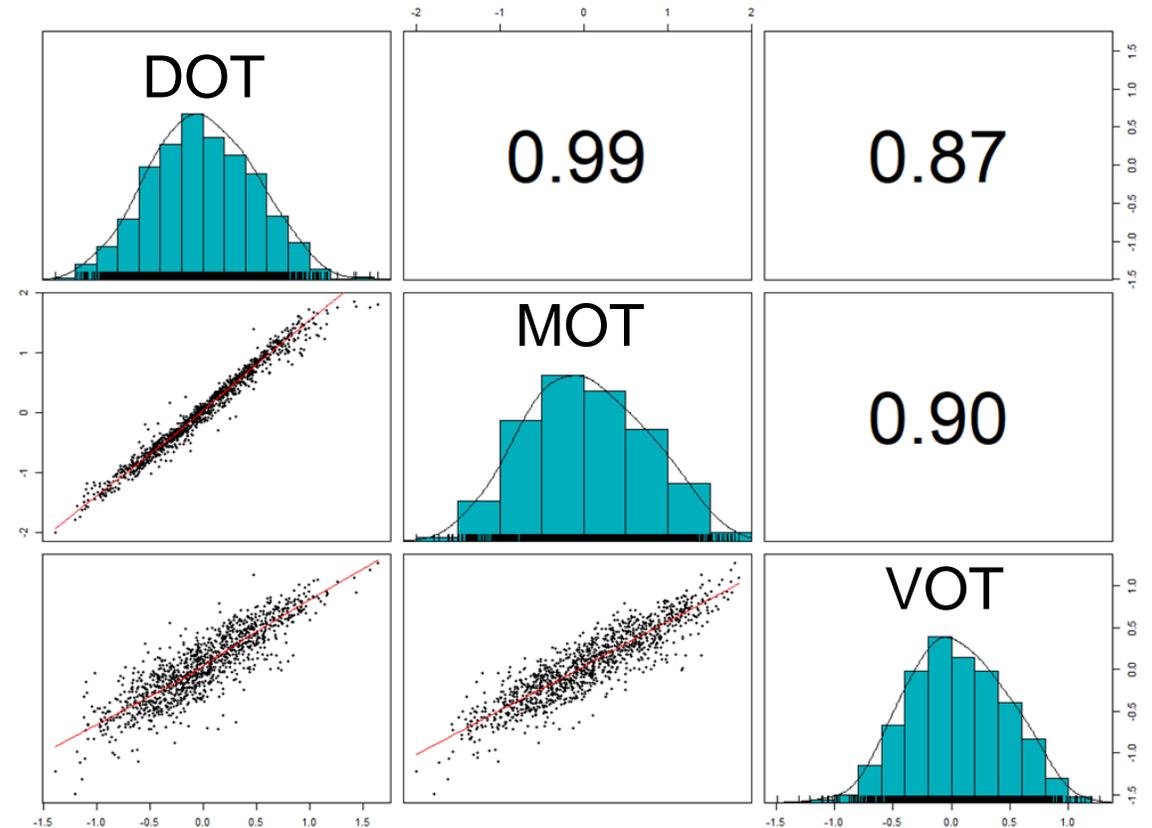
➤ Genetic background of oviposition time remains stable between 24-64 wks.

➤ Whole period and summarized traits

	Heritability
Daily oviposition time (DOT)	0.35 (0.04)
Mean oviposition time (MOT)	0.73 (0.08)
Var oviposition time (VOT)	0.42 (0.07)

- Higher heritability for the mean
- Same ranking of candidates (+0.99) between daily and mean oviposition time

Spearman's rank correlation between the EBVs of hens



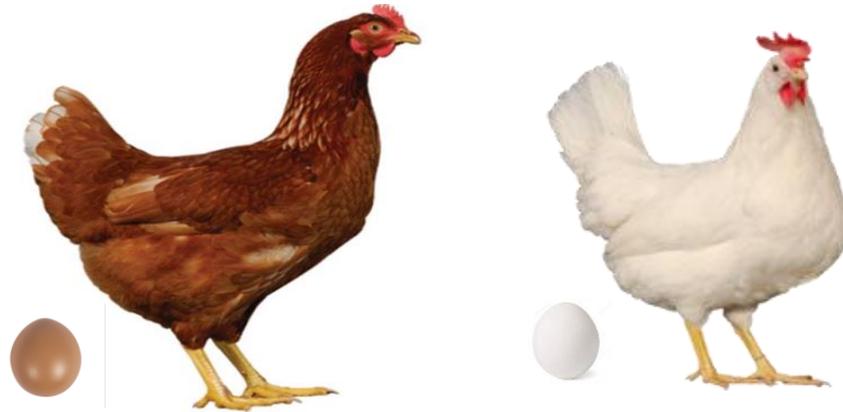
➤ How use oviposition time for breeding selection?

- Daily oviposition time:
 - Moderately heritable and stable between 24-64 wks.
 - Same ranking of candidates than the mean
 - Similar results with the White Leghorn line
- Application for breeding selection on oviposition time: summarized data > repeated records
 - Calculation time of EBVs faster
 - Store and manipulate less data (two by hen vs one by oviposition)

➤ And what else?

- Improve the laying rate = ↘ the mean and variance of oviposition time
- Cage-free: differentiate break and floor eggs
 - Results on the same populations in Bécot et al. 2021, Plos One
- Other traits like resilience/robustness?
- Vigilance points:
 - Select hens that lay at the same time and more earlier (the night?)
 - increase floor eggs!
 - Egg qualities

Thank you for your attention



lorry.becot@inrae.fr