How to select the laying hen of the future?

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HOW TO SELECT THE LAYING HEN OF THE FUTURE?

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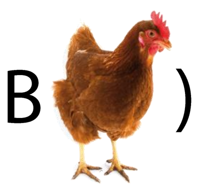
Introduction: Climate change, changes of poultry diet composition, development of extensive production systems to match consumers expectations for welfare have raised the demand for more robust laying hens, i.e. hens that are able to cope with changing conditions and to recover after a stress. Hendrix Genetics is thus looking for ways to improve this robustness by selection, without compromising production.

In this context, the project « Gallus Futurus » in collaboration with Hendrix Genetics, INRA (France) and the University of Wageningen, aimed at evaluating the robustness of laying hens in response to heat waves, feed stresses and floor rearing conditions (with or without laying nests) in two pure lines. We first evaluated current and novel phenotyping methods to check whether these methods were able to detect differences between pure breeding lines which are known to be different with regards to robustness characteristics. We then identified different patterns of response to stress based on the different phenotypes recorded, to create an index of robustness. At last, for traits recorded in both stressful and control conditions, we estimated the genetic correlations between the different rearing conditions to quantify the intensity of the genotype-environment interaction.

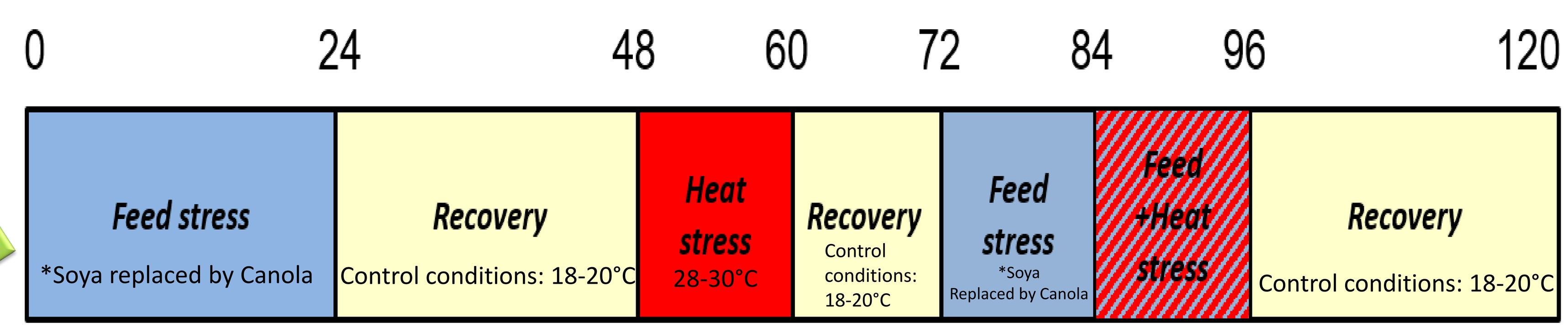
Material and methods:

2400 hens (½ Line A , ½ Line B )

12 pens (8 with collective nests, 4 with individual nests)

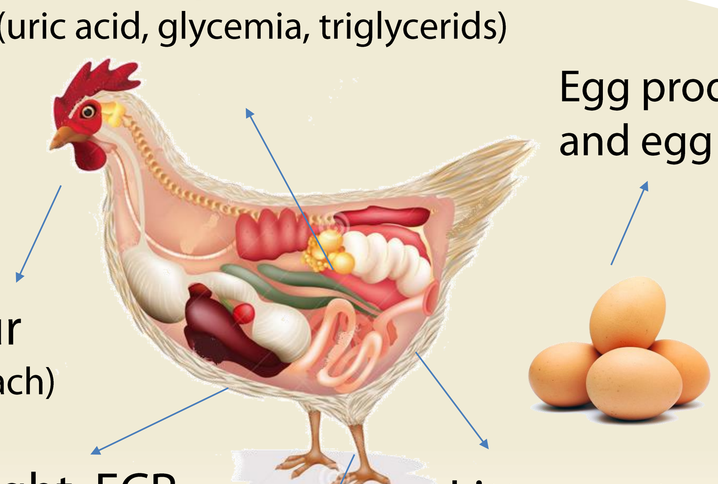
→ ½ in control conditions

→ ½ exposed to 3 cycles of feed/heat stress



Composition of a cycle of stress in days

Phenotyping:



Aim1:

Evaluation of the current and novel phenotyping methods

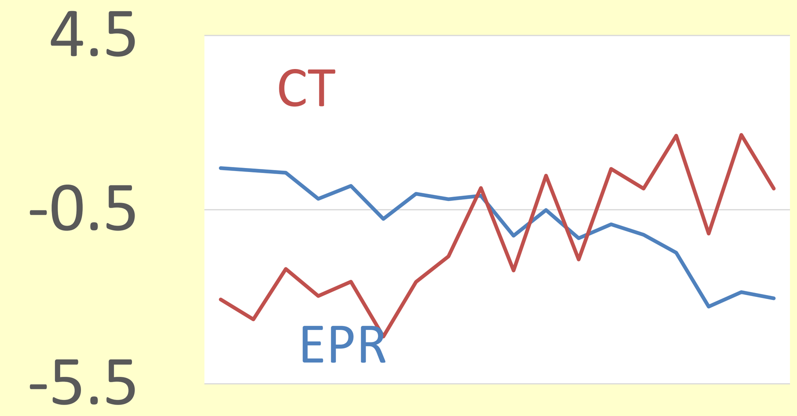
1/ Classical phenotypes :
Higher sensibility of line B to heat stress, with a decrease of performances during heat waves compared to line A (-3.6 v.s 1.4% for egg weight, -5.7% v.s 1.8% for body weight. These different results are consistent with previous knowledge on these lines.
Very few effects were observed for feed change (for example: -0.1% for egg weight of line A and +0.8% for line B with the alternative diet).

2/ Novel phenotypes:
Leg and comb temperatures seems to be good indicators of the birds' adaptation to heat stress. A simplified method to extract the leg temperature should make it useable in practice.

Aim 2:

Index of robustness

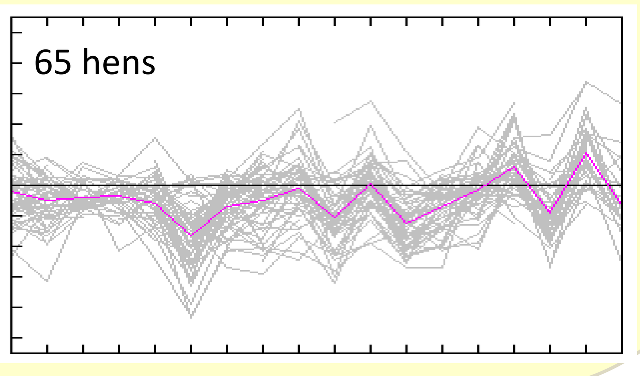
1/ A principal component analysis was used to create a composite trait (CT) correlated to heat stress reaction:
*CT= 0.76*Egg weight + 0.78*redness index of the yolk + 0.43*Body weight + 0.49*hematocrite -0.73* Leg temperature*



3/ Clustering strategy to identify different patterns of response to stresses with the CT estimated for each animal (MEV4.0 software).

Identification of groups of hens with the same pattern of responses to stress.

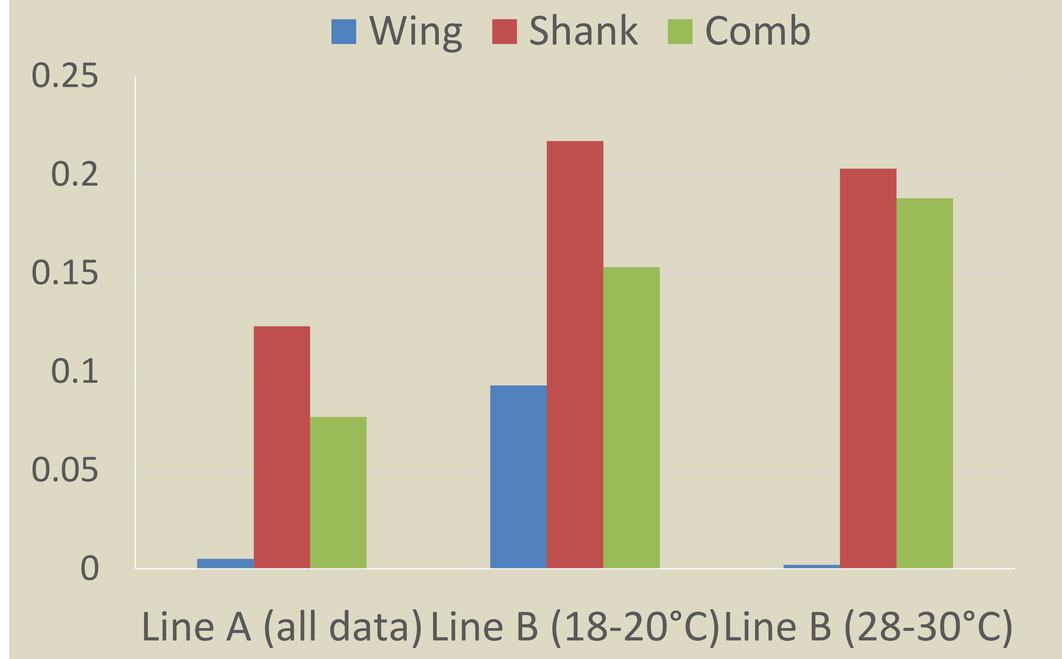
Exemple of a group of hens with return to zero after a stress: the most robusts hens?



Aim 3:

Estimation of genotype-environment interaction

Ex: Genetic parameters of Body surface temperature



Genetic correlation between hot and and thermo -neutral parameters in line B:
Wing: 0.98 ± 0.74
Shank: 0.95 ± 0.05
Comb: 0.99 ± 0.03

Comb and Leg temperature are partly under genetic control. Genetic control is identical in both hot and thermo-neutral conditions.
Perspectives for selection of more robust hens?

Conclusion: This analysis identified the most consistent phenotypes to evaluate robustness, mostly for heat stress. Infrared thermography seems to be a reliable method to measure heat exchanges. Leg and comb body temperature are partly under genetic control and could be used as selection criteria. For the future, estimating a composite trait related to robustness to heat stress associated with clustering is a promising strategy for the selection of robust laying hens.

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