Multiperformance of slow-growing and dual-purpose strains in organic chicken production: learning from the PPILOW project

Claire Bonnefous, Cesare Castellini, Simona Mattioli, Sandrine Mignon-Grasteau, Julie M Collet, Laurence A. Guilloteau, Bertrand Méda, Théophane de Rauglaudre, Helen Pluschke, Petra Thobe, et al.

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Multiperformance of slow-growing and dual-purpose strains in organic chicken production: learning from the PPILOW project

Bonnefous C., Castellini C., Mattioli S., Mignon-Grasteau S., Collet J., Guilloteau L.A., Méda B., de Rauglaudre T., Pluschke H., Thobe P., Werner D., Calandreau L., Guesdon V., Steenfeldt S., Germain K., Ravon L., Berri C., Lombard S., Reverchon M., Le Bihan-Duval E., ***Collin A.***

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 816172

PPILOW What is multiperformance for broiler production?

Economic performance

Zootechnical parameters
Meat yeald
Costs and revenues
…

Animal Welfare performance

5 freedoms
Freedom from Hunger and Thirst
Freedom from Discomfort
Freedom from Pain, Injury or Disease
Freedom to Express Normal Behavior
Freedom from Fear and Distress

the Farm Animal Welfare Council, 1993

Satisfaction of physiological and behavioural needs, as well as expectations ANSES, 2018

MULTI-PERFORMANCE

Environmental performance

Energy and water use
Climate change
Pollution
…

Animal health performance

Absence of disease
Food safety
Immunity and adaptive capacities
…

Societal performance

Work conditions
Job perception
Social involvement
Meat quality and food security
…

Some indicators shared with those included in multicriteria sustainability assessments

Why do we consider multiperformance in organic broiler systems?

- Diversity of practices and breeds used with different performance and environmental impacts throughout Europe

- Still a need to improve animal welfare and limit mortality, in relation to the **outdoor access challenging the animals** and **ethical issues**

Objective of PPILOW: Identify, test and evaluate animal welfare-improving practices by taking into account environmental, economic and social impacts including human well-being

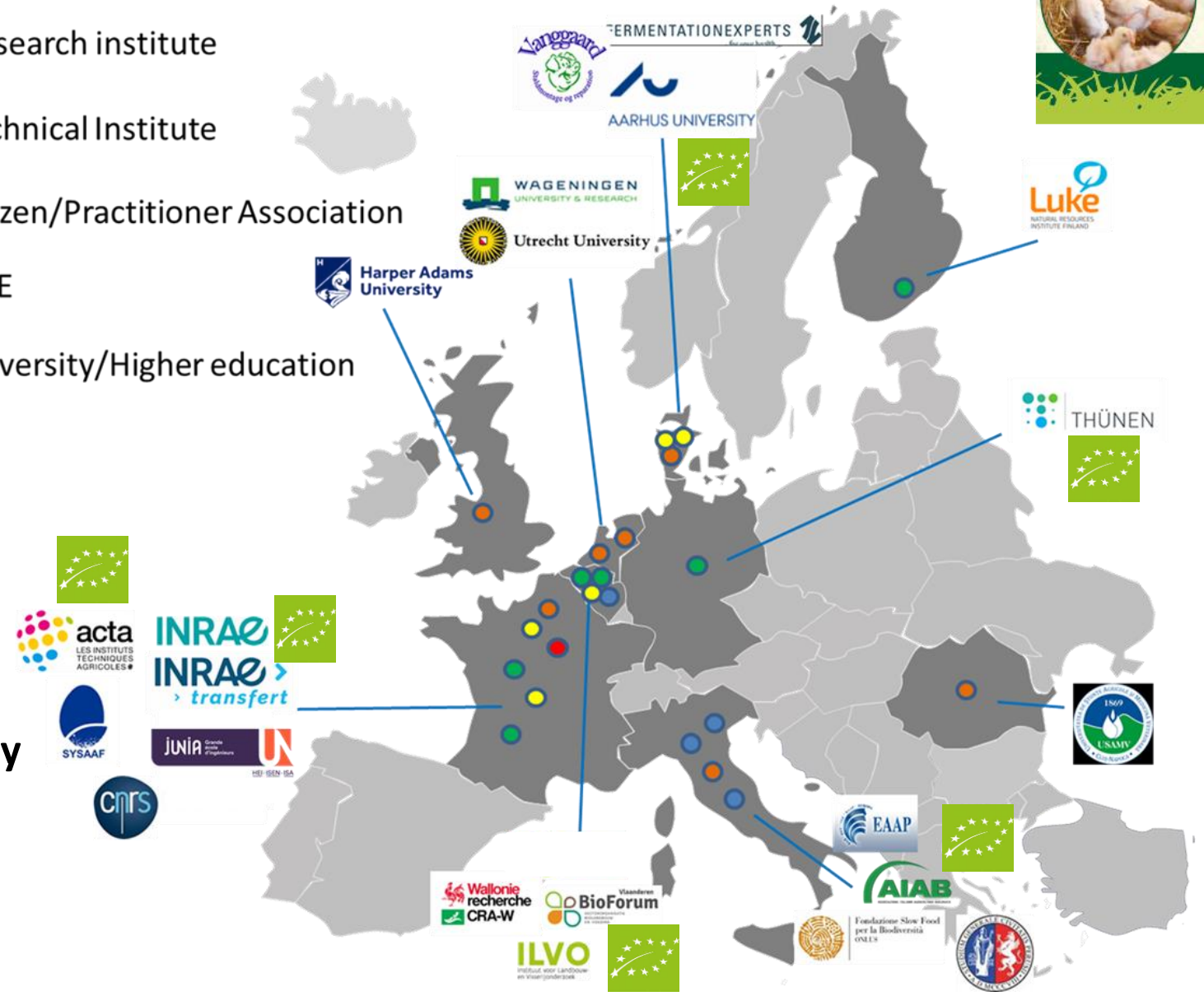
One Welfare concept (Garcia Pinillos et al., 2016) and *Multiperformance*

H2020 PPILOW partners and collaborators

PPILOW
Poultry and Pig Low-input and Organic production systems' Welfare

2019-2024

- Research institute
- Technical Institute
- Citizen/Practitioner Association
- SME
- University/Higher education



Coordination: INRAE

22 PPILOW Partners in 9 countries

9 National Practitioner Groups (NPG): 5 dedicated to poultry

www.ppilow.eu

PPILOW Involvement of National Practitioner Groups

Favouring positive behaviours, improving health and robustness

Avoiding feather pecking in non beak-trimmed hens and the elimination of layer male chicks

Broilers in organic free range systems (PPILOW WP6.1)

Free-range

Key request for European consumers : **Expression of species behaviours** (walking/running, foraging, social interactions…) **- welfare**

Interesting functions for the **agroecological transition** (nutrient inputs from plants and insects, closing nutrients cycles, biodiversity…)

Potential benefits are subject to the fact that **poultry use the outdoor space**…
and are able to maintain **good performances, health and welfare** when exposed to biotic or abiotic stressors on the range

- **Variability of range use** between **indivuals from different genetic lines** of broilers and **trade-offs between functions**

Dual-purpose breeds in organic systems (PPILOW WP5)

National legislations and knowledge for practitioners and European policy makers:

Alternatives to the elimination of layer male chicks

Layer strain — *Selection based on egg production, egg quality traits* — ~~*Culling of layer male chicks*~~

FR: Article R214-17

- From 01/01/2023 : all hatcheries have to be equipped with operational material to avoid culling chick in coloured strains

DE: Article TierSchtG Art. 1 § 4c

- From 01/01/2022 : makes it a punishable offence to kill a vertebrate animal "without reasonable cause" (unprofitability) or to cause it suffering and pain

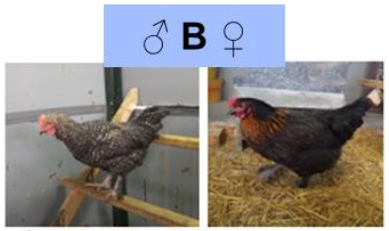
Two strategies developed in PPILOW

- Study of dual-purpose strains experimentally and on-farm

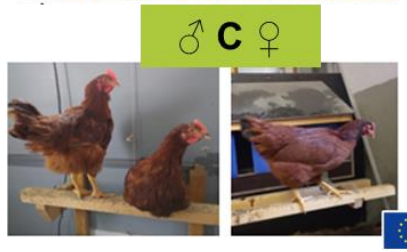
Multiperformance data, multicriteria analysis and business models

ACTA(ITAB)
Thuenen Institute
Aarhus University
INRAE
SYSAAF

Meat-type



Pure breed



Layer-type

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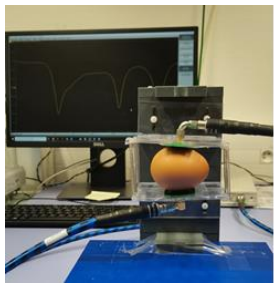
Pluschke et al., EAAP 2024

- Development of an on-ovo sexing tool:
Non invasive method
As early as possible



PPILOW Multiperformance of organic broiler production in PPILOW?

Economic performance

Zootechnical parameters / growth performance
Meat yeald
Costs and revenues

Animal Welfare

5 freedoms
Freedom from Hunger and Thirst
Freedom from Discomfort
Freedom from Pain, Injury or Disease
Freedom to Express Normal Behavior
Freedom from Fear and Distress

Satisfaction of physiological and behavioural needs, as well as expectations

Animal welfare assessments
Range use

Environmental performance

Energy and water use
Climate change
Pollution

Multiperformance

Animal health

Absence of disease
Food safety
Immunity and adaptive capacities
Bone health and redox status

Societal performance

Work conditions
Job perception
Social involvement
Meat quality and food security
Consumer preference

Multiperformance of broilers from different breeds and range use (France), WP6

3 strains: 1 per range; 750 animals per strain ; 50% males, 50% females

WP6

Dual-purpose C strain
16 g/d
(reared for 14 weeks)

JA757 strain
36 g/d
(reared for 10 weeks)

S757N strain
26 g/d
(reared for 12 weeks)

29 d — 36 d — 57 d — Slaughter age

Weight

Range access

Weight

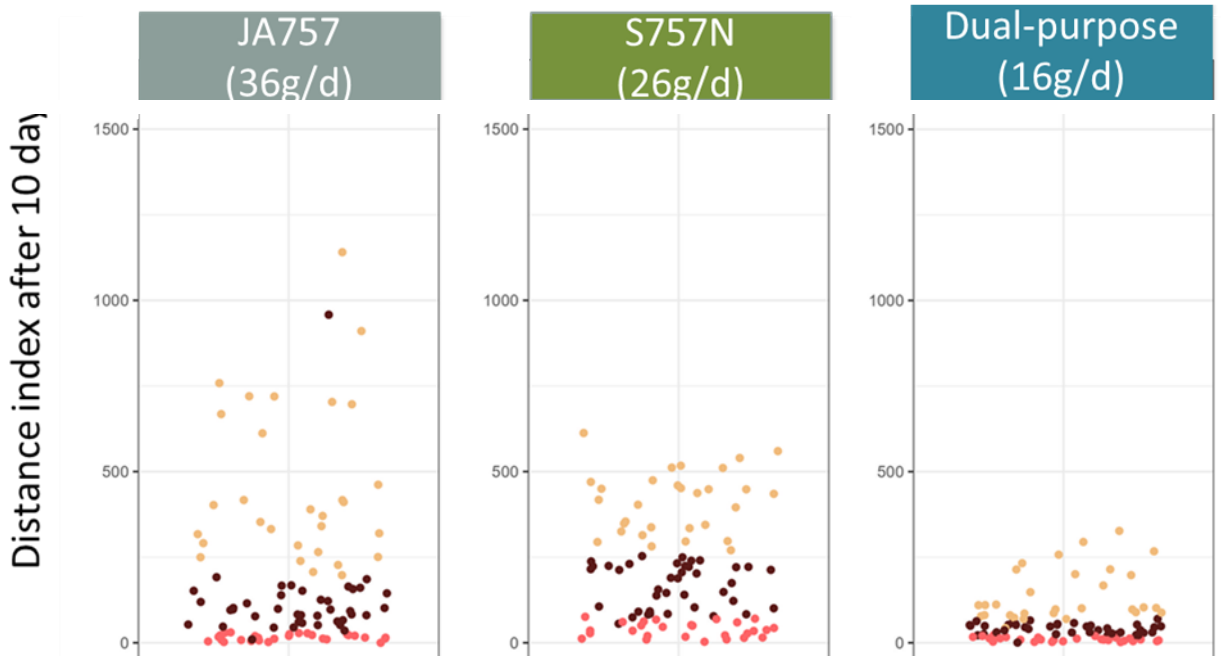
- Welfare indicators
- Performances and meat quality
- Blood parameters

Bonnefous et al., 2023
Collet et al., 2024

Results - Variability of individual range use (WP6)

Evaluation of individual Range Use by the Distance Index from scan samplings (N=100 males per line)

Impact of range use variation within strains?



Selection :
25 animals with the lowest Final Distance Index = low-rangers
25 animals with the highest Final Distance Index = high-rangers

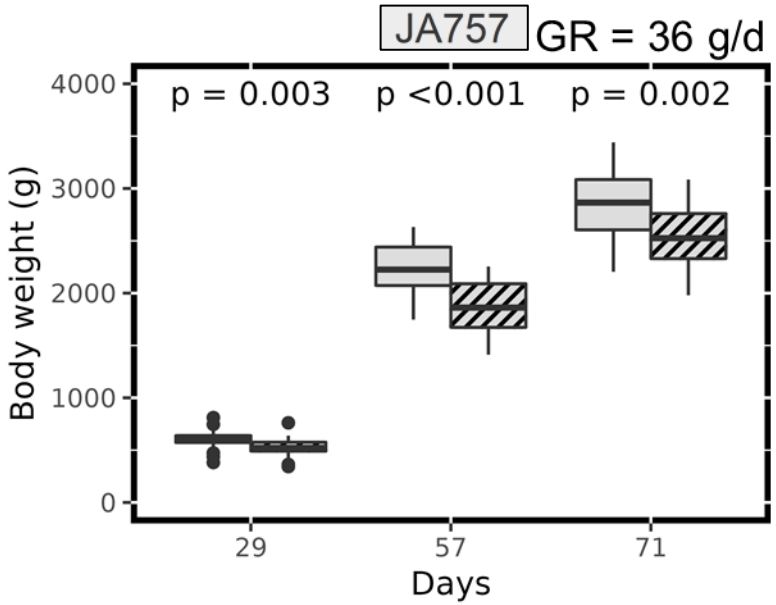
Age at slaughter (d)	**86**	**100**	**121**
Cumulated time spent outdoor (hr)	108 419	296 741	212 699

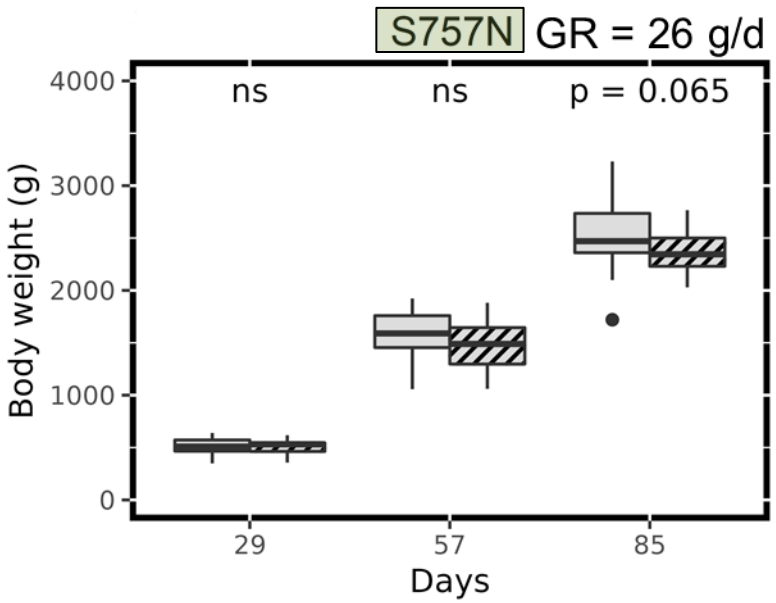
Bonnefous et al., 2023

Follow-up by RFID
Collet et al., 2024

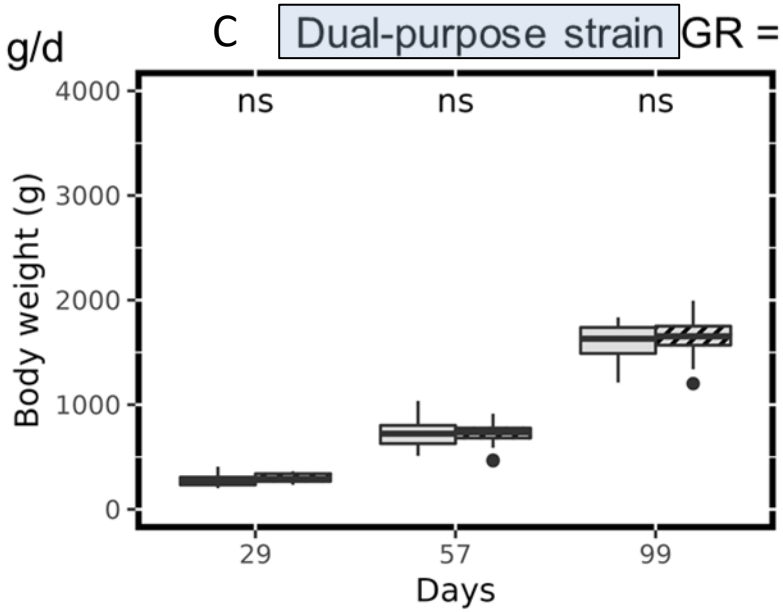
Growth performance - Relationship between range use and body weight?

Lower BW predisposal factor to higher range use?
HR birds already more active before range access?





Higher range use tends to impair final BW



No relationship between range use and body weight

Low-rangers
High-rangers

WP6

Bonnefous et al., 2023

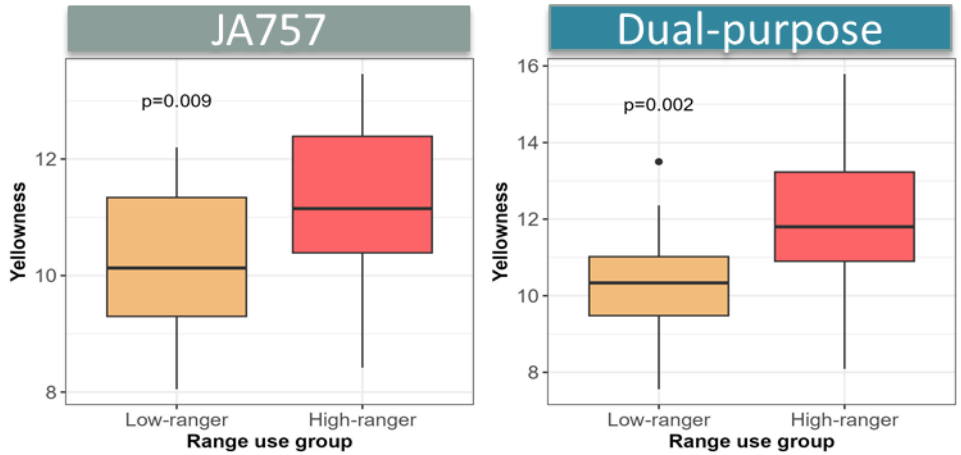
Economic performance
Societal performance

Results - Range use and meat production and quality? WP6

	JA757		S757N		Dual-purpose	
Range use	Low	High	Low	High	Low	High
Breast weight (g)	233	201	183	168	83	84

In all strains but the dual-purpose, carcass/breast/thigh weights higher in Low Rangers than in High Rangers

Yellowness



Foraging favors the intake of grass that contains coloring carotenoids

Bonnefous et al., 2023

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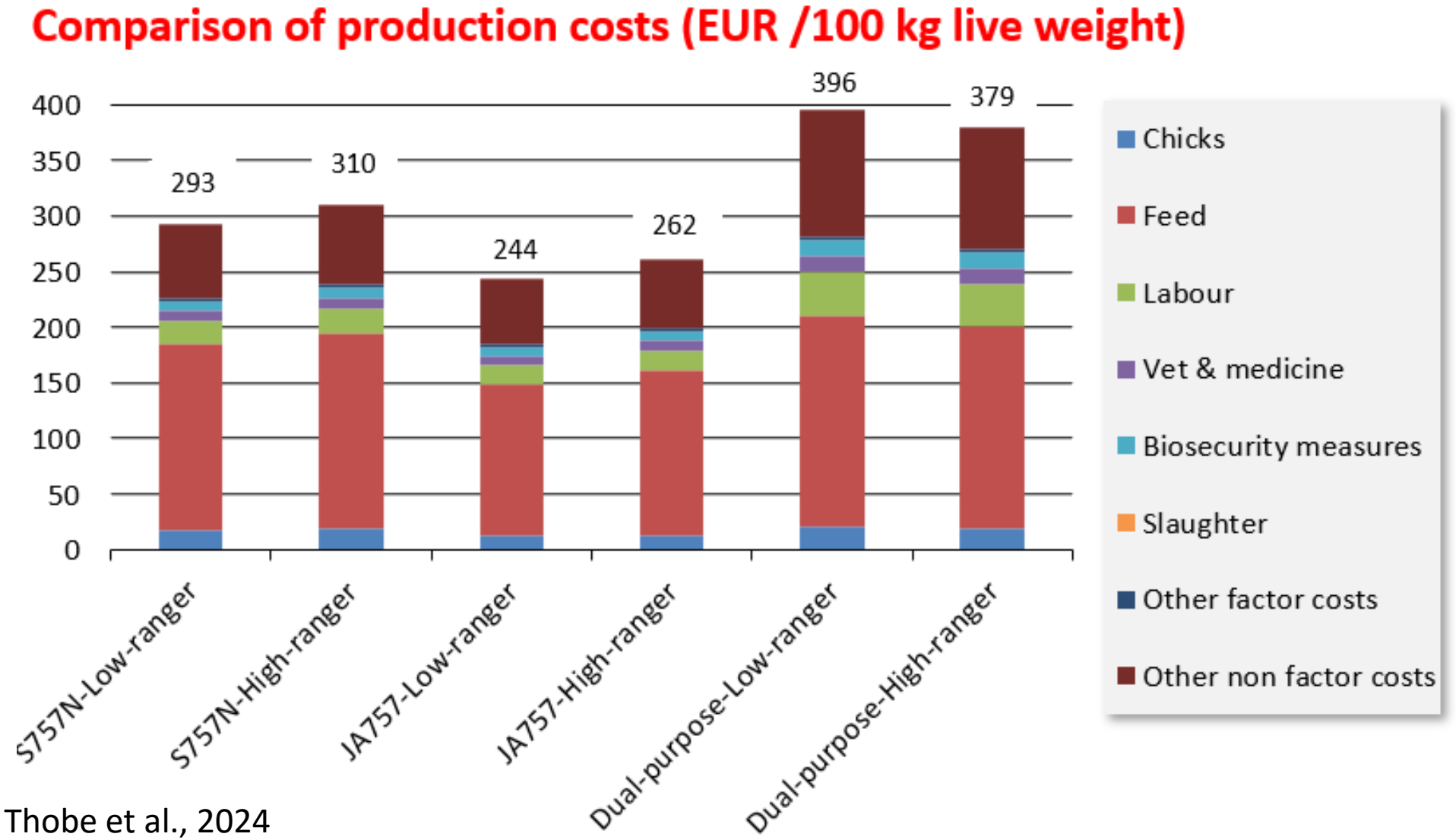
Economic performance

Calculated from 2021 data



Thuenen Institute, Thobe et al., 2024

PPILOW Comparison of the on-station fattening performances of dual-purpose breeds - males (WP5)

Meat-type Crossbreed

Genotype A	Denmark	Germany	France Spring / summer	France Autumn / winter
Live weight wk 12, g	2019	2203	1977	1885
FCR	3.1	3.4	3.3	3.4

Pure breed

Genotype B	Denmark	Germany	France Spring / summer	France Autumn / winter
Live weight wk 12, g	1645	1763	1577	1466
FCR	3.3	3.5	3.4	3.7

Layer-type Crossbreed

Genotype C	Denmark	Germany	France Spring / summer	France Autumn / winter
Live weight wk 12, g	1732	1634	1393	1551
FCR	3.1	3.7	3.2	3.6

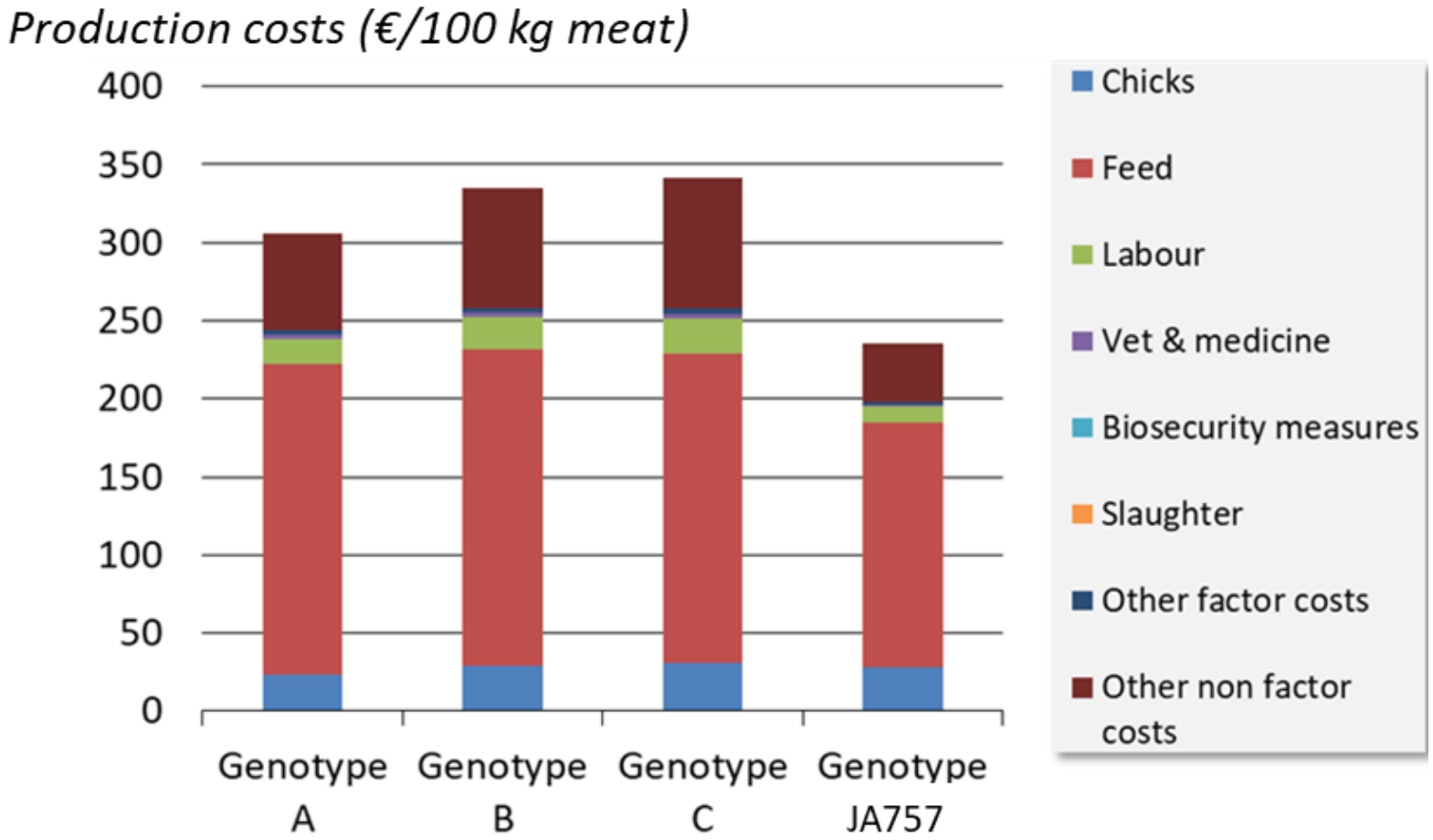
Lombard et al., 2024

PPILOW

Production costs of the use different dual-purpose breeds in organic experimental facilities in Germany in WP5 - males

Thuenen Institute

Calculated from 2021 data



Thobe et al., EAAP 2023

PPILOW – Dual purpose females

Results ♀

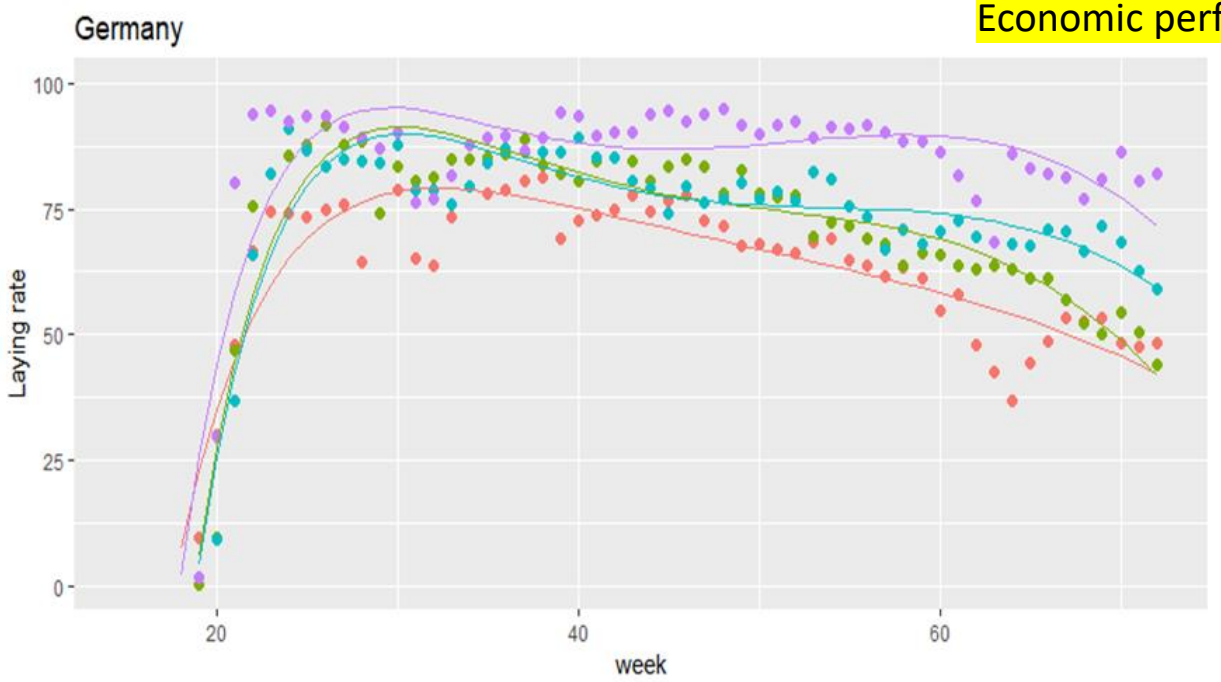
Evolution of the laying rate through time

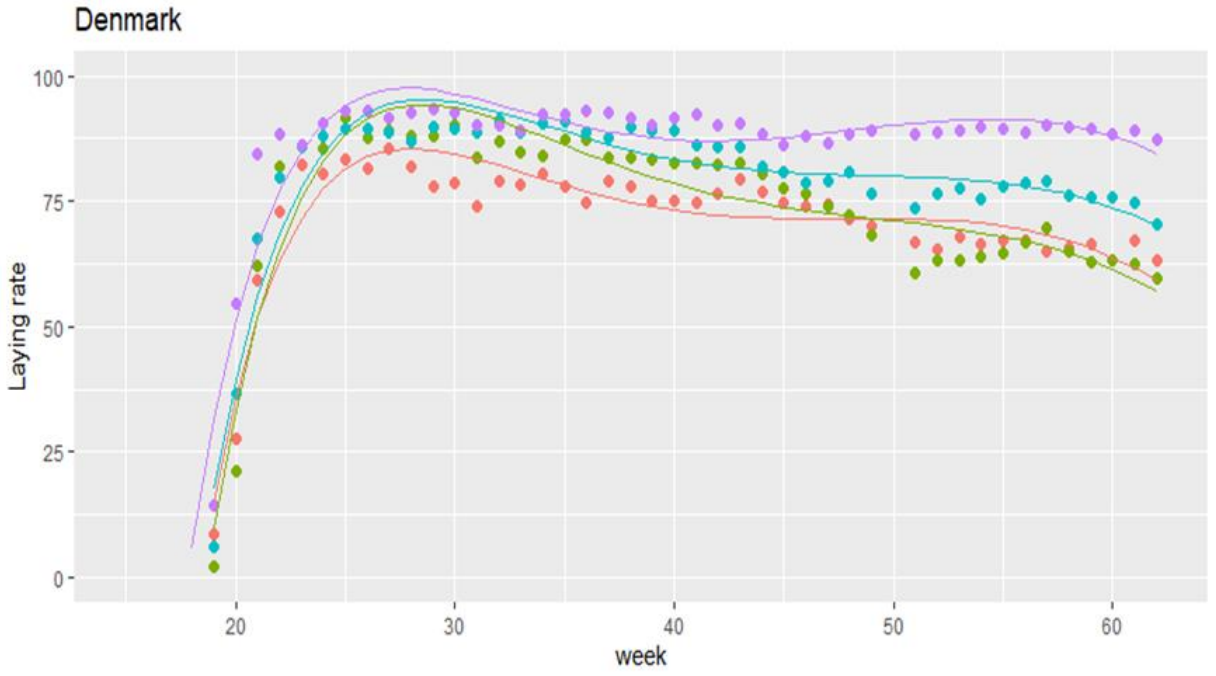
Laying rate recorded every week from week 19 to week 72 in Germany and week 62 in Denmark

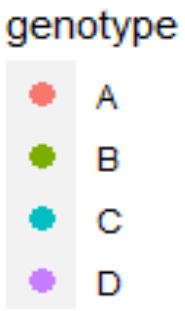
Genotypes D laying peaks higher than any of the dual-purpose lines and sustained for a longer period of time

Genotype A always showed the lowest laying peak

Laying persistence: **genotype B < C**



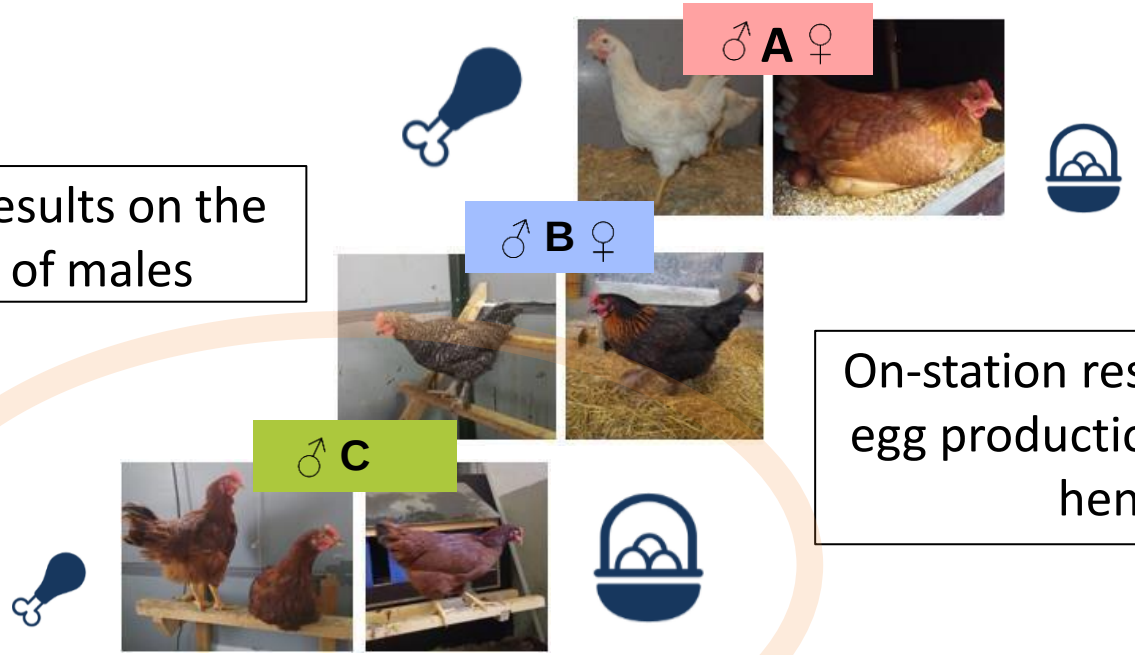




Lombard et al., 2024
Pluschke et al., EAAP 2024

PPILOW Genotypes & National Practitioner Group decision in WP5

On-station results on the fattening of males



On-station results on the egg production of laying hens

Based on the laying data that represents the biggest part of revenues from dual-purpose genotypes, the NPG in each country selected the genotype to be tested on farm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 816172

PPILOW On-farm trials results – Technical data WP5

Economic performance
Animal health

	France		Germany	
	C	F (S757N)	C	D (JA757)
Mortality, %	4.6	1.4	11	1.2
FCR (13 wk)	3.7	2.6	3.7	2.7
Carcass weights at 13 wk, kg	1.38*	1,98*		2.4
Carcass weights at 15 wk, kg	1.72*	2.41*		
Carcass weights at 16 wk, kg			1.8	

* Including neck

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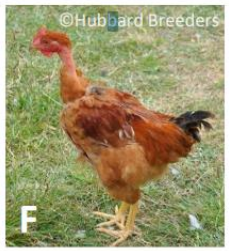

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Lombard et al., PPILOW final Conference, 2024

PPILOW On-farm trials results – Carcass characteristics in France (WP5)

Economic performance

Societal performance

At week 13: Avg ± SE

	C	F (label)
Legs weight (g)	448 ± 9	668 ± 12
Wings weight (g)	180 ± 3	246 ± 4
Breast weight (g)	201 ± 5	354 ± 11

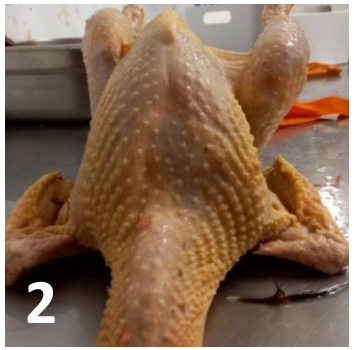
At week 15 : Avg ± SE

	C	F (label)
Legs weight (g)	574 ± 12	838 ± 9
Wings weight (g)	219 ± 6	286 ± 3
Breast weight (g)	269 ± 4	462 ± 6

C cuts from 40 to 30% lighter than F (label-type) cuts

Carcass conformation scores

	Genotype	Score 0	Score 1	Score 2
Wk 13	F (label)	**100%**	0	0
	C	0	0	**100%**
Wk 15	F (label)	**97%**	3%	0
	C	4%	**39%**	**58%**



Direct sale on-farm :

- Consumers quite satisfied to buy small carcasses
- Interest for the approach
- But not sold at higher price

Farmer enthousiastic with the ethical concept but technical adjustments and support needed

Lombard et al., 2024

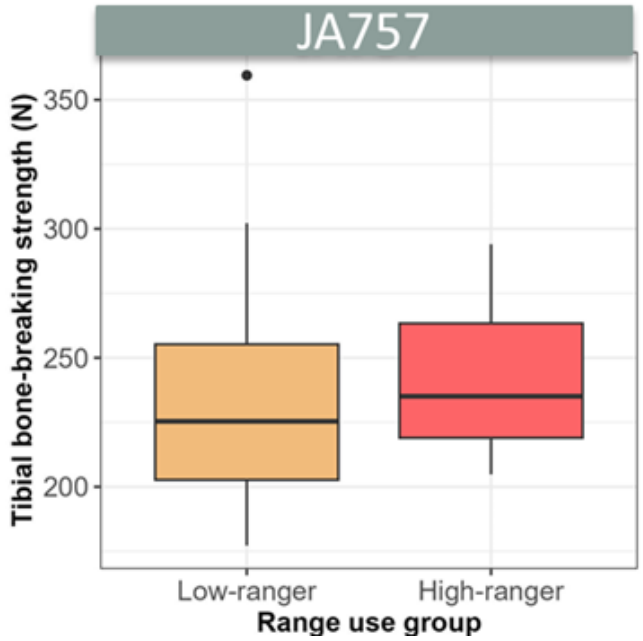
PPILOW

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 816172

Welfare and health indicators? Different breeds on the free range (WP6)

	JA757		S757N		Dual-purpose	
Pododermatitis (severe)	48%	40%	16%	12%	0%	0%
Hock burn % (severe)	8%	0%	0%	0%	0%	0%

Low Rangers High Rangers



Range use

Bone health
HR>LR in JA757
Higher locomotor activity
of high-rangers

Bonnefous et al., 2023 [20]

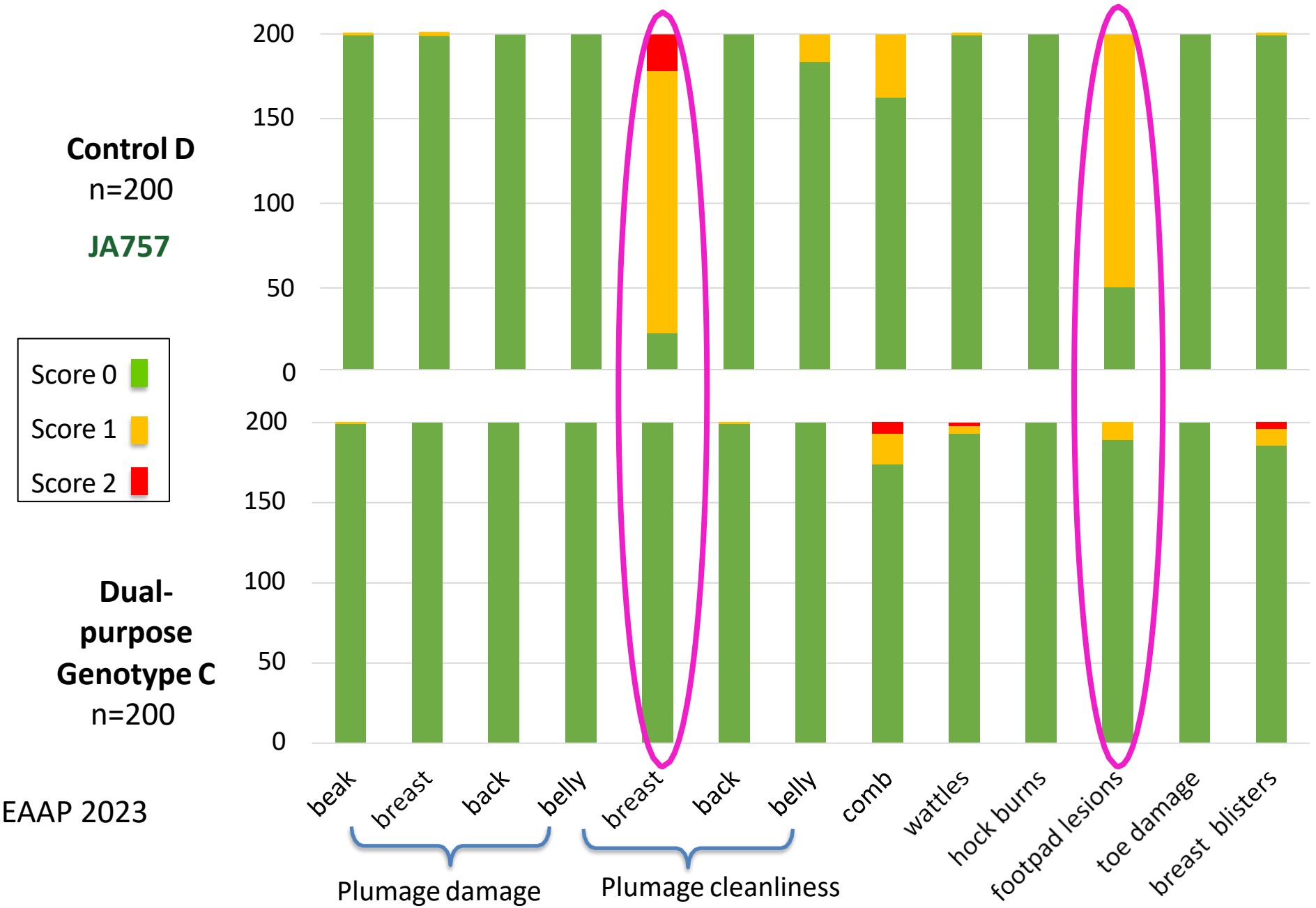
Animal Welfare

Animal health

PPILOW On-farm trials results – Welfare indicators in Germany (WP5)

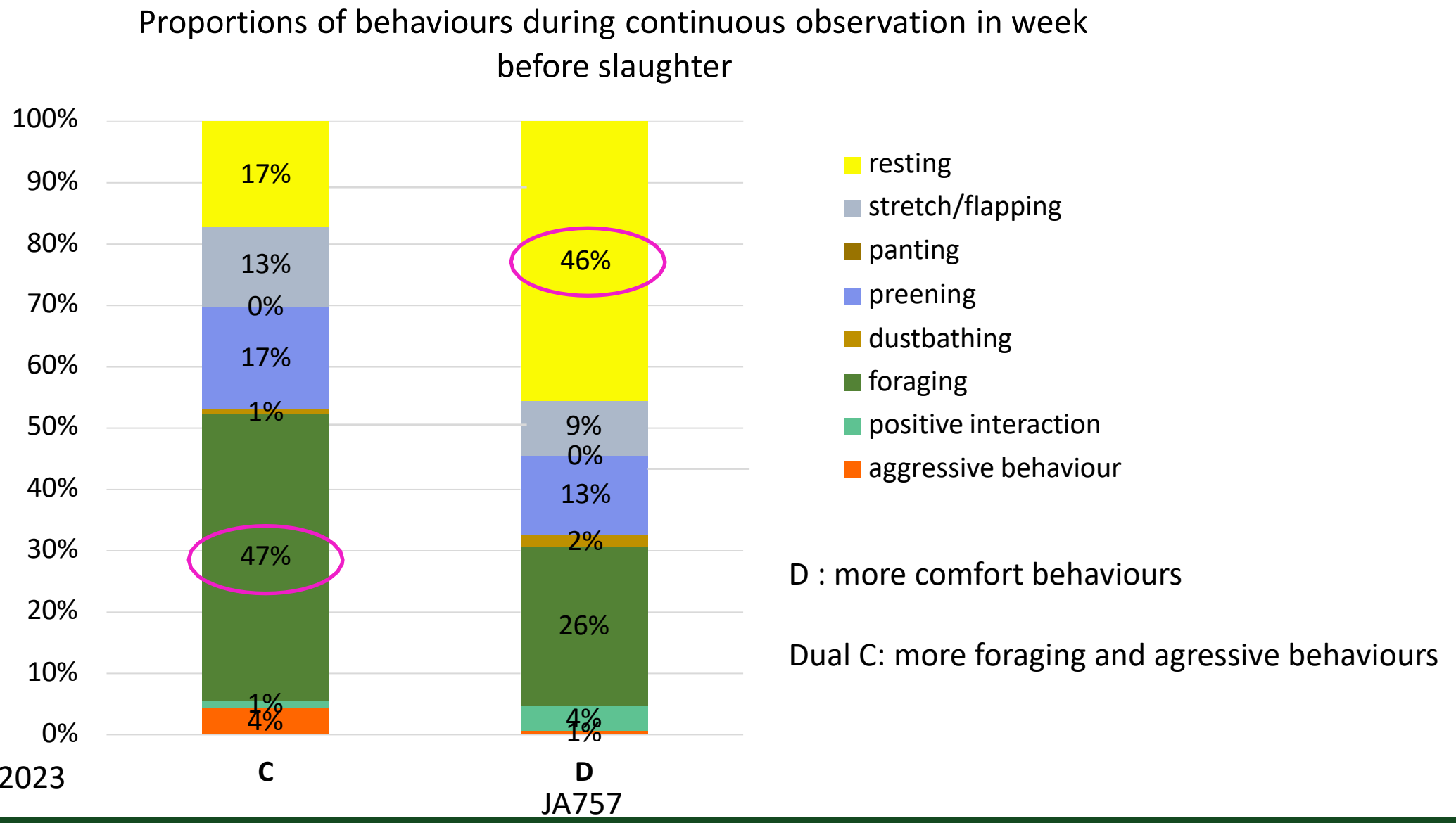
Control D
n=200

JA757



Pluschke et al., EAAP 2023

PPILOW On-farm trials results – Behaviour Observations in Germany in WP5



D : more comfort behaviours

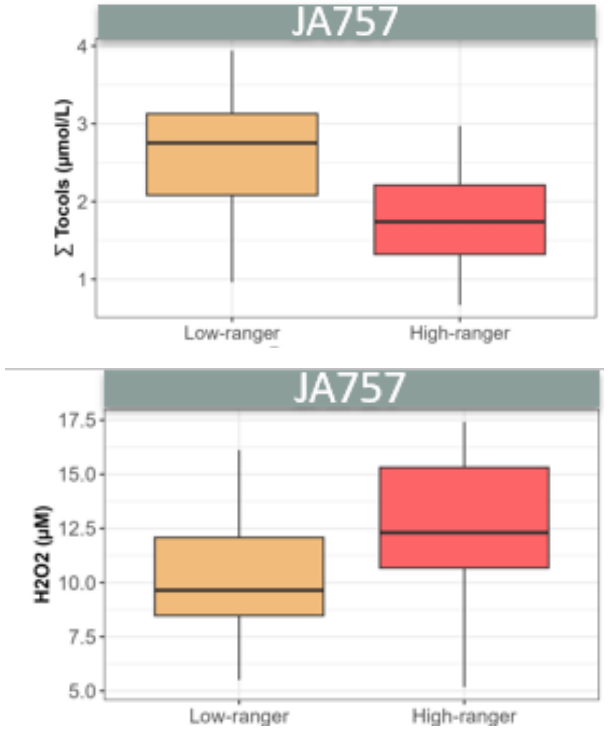
Dual C: more foraging and agressive behaviours

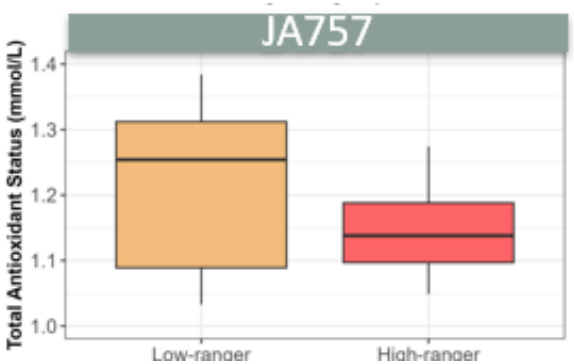
Pluschke et al., EAAP 2023

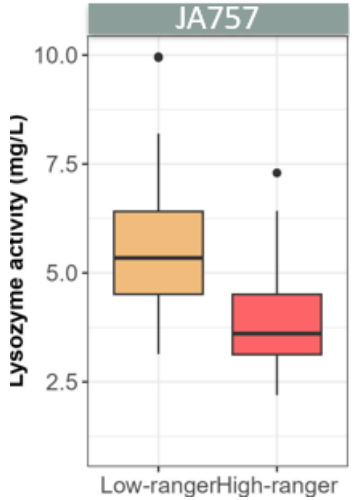
Results - Relationship between range use and **bird physiology (WP6)?**

Redox status

Antimicrobial defense







Low Rangers

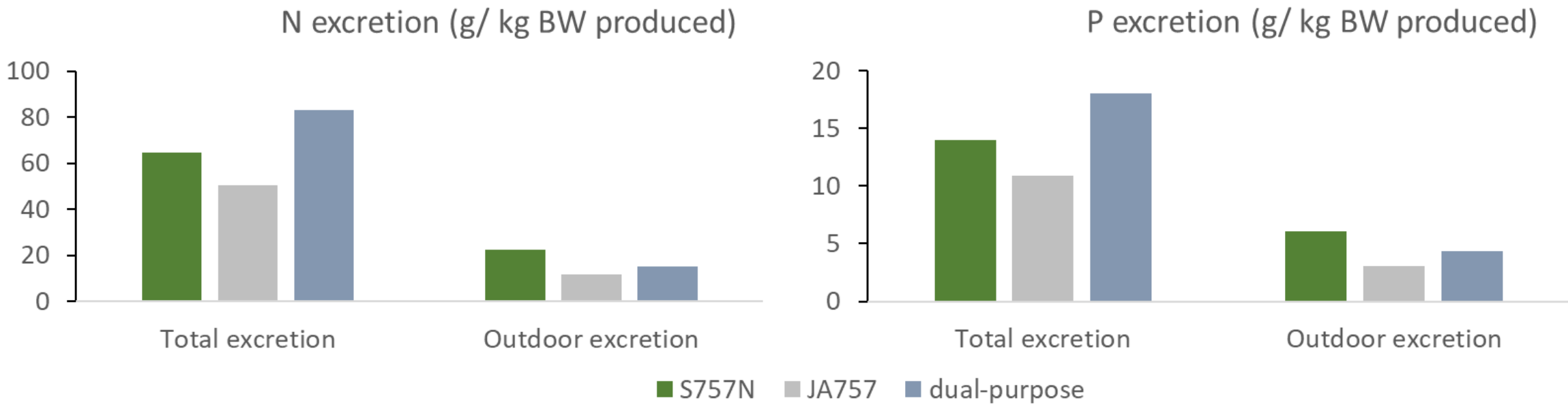
High Rangers

In medium-growing birds, higher physical activity (in High ranging group) may limit muscle antimicrobial potential and increase oxidative stress

Bonnefous et al., 2023 [23]

Results – Nutrient excretion (WP6)

Measure	S757N	JA757	Dual-purpose
Total feed intake (kg)	6207	6072	5332
Average weight per animal at commercial slaughter (kg)	2.6	3.2	1.9
Average feed conversion ratio (g/g)	**3.2**	**2.7**	**3.8**

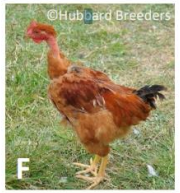


Lower nutrient excretion with medium-growing JA757

The quantity and distribution of outdoor excretion depends on the breed and range design

Bonnefous et al., EAAP2023

Working conditions, job perception and meat sensory quality compared to control label-type animals



- **JA757**: shorter rearing period, easier catching despite additional cleaning and straw bedding, lower stress and healthy working environment for the farmer

- Additional care needed for new **dual-purpose genotype C** :
  - smaller birds (feeders to adjust, feed spillage),
  - longer time indoors before range access (thermoregulory needs),
  - much enrichment needed from start to avoid feather pecking,
  - quite stressful for the farmer/caretaker despite ethical interest

© Photos / Pluschke

- The **meat of all strains was judged to be good** considering sensory quality

Conclusions (1)

Interest of a **multi-trait approach** to evaluate the multiple consequences of range use and search for well-adapted breeds or birds

- Best growth performance and **lowest nutrient excretion** with **medium-growing JA757 strain** with the best (lowest) feed conversion ratio.

- Good meat quality parameters
- Good perception by farmers/caretakers

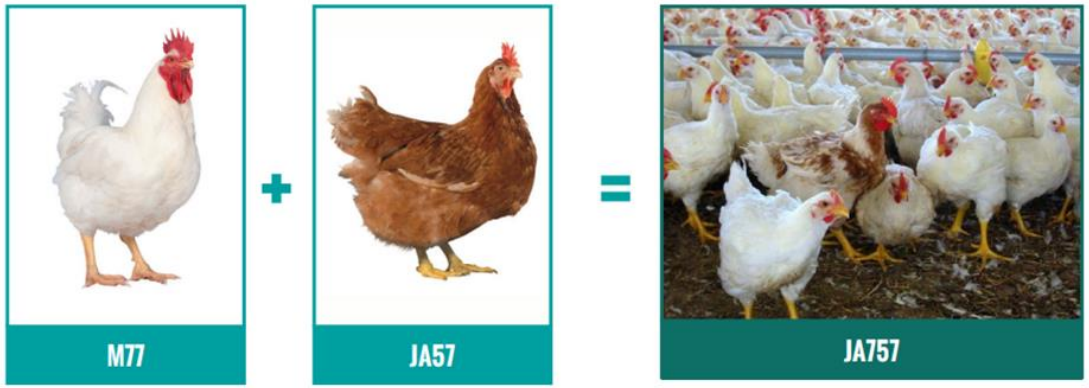
Reasons why it has spread in organic farming throughout Northern Europe

But…

Animal welfare impaired in our conditions (FPD), and redox status/health parameters affected in high-ranging animals…

… and **what about the breeders?**

Fast-growing male parental line



Feed restriction:
Sustainability of the whole production chain?

Conclusions (2)

- **Regulation (EU) 2018/848** of the European Parliament and of the Council **on organic production and labelling of organic products** and repealing Council Regulation (EC) No 834/2007.

Organic chickens born as organic chick: from organic breeders having access to the outdoor range

Questions about the genetics and breeding conditions – Exemption until 2036

- **Label-type (slow-growing) chickens**:
  - Selection on a combination of range use (assessed by RFID) and growth?
  - Outdoor rearing of parental flocks and possibility of using a veranda during sanitary events?

- **Consider slow-growing breeds (among which local ones) in interaction with the free range design (agroforestry)?**

Presentation of Castellini, EAAP 2024

Conclusions (3)

- **Development of dual-purpose breeds in organic systems?**

  - For some organic farmers: the only ethical way to avoid the culling of layer male chicks
  - Sustainability gains to find by nutrition (using by-products) for lower costs and management?
  - Marketing actions towards consumers and public support?
  - Consider laying performance together with meat production: cost of eggs and meat!

Slow development in the absence of EU regulation *on the culling of male chicks but only national ones*

Towards sustainability assessments *taking into account* ***all the dimensions*** *considered in "****multiperformance****",*
e.g. ***including Animal Welfare (and health)***
All stages of the production chain to be considered?

Network of the European Partnership on Animal Health and Welfare (EUPAHW*) to work on this topic

*The European Partnership on Animal Health and Welfare is co-funded by the European Union's Horizon Europe Project 101136346 EUPAHW

PPILOW **PARTNERS**

Thanks to all the collaborators involved to to the members of the National Practitioner Groups!

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Thanks for your attention!

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