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Description and consequences of variability in sows and piglets

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INRA SCIENCE & IMPACT

Feed-a-Gene
Adapting the feed, the animal and the feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems

The Feed-a-Gene Project has received funding from the European Union's H2020 Programme under grant agreement no 633531.

Context

Large panel of genotypes

See L. Bodin's presentation

Pure bred sows and piglets

[...]

[...]

Crossbred sows and piglets

Let's consider one farm (i.e., one genotype)

Variability → SOWS ↕ PIGLETS

SOWS: parity; proli-ficacy; milk; ...

PIGLETS: birth weight; survival; growth potential; ...

Toward a change of paradigm (feeding strategy, management…)
➔ from the herd to the individual (pen) level

Feed-a-Gene

Prolificacy changes over time and parity
at the national (1) and the herd (2) scales

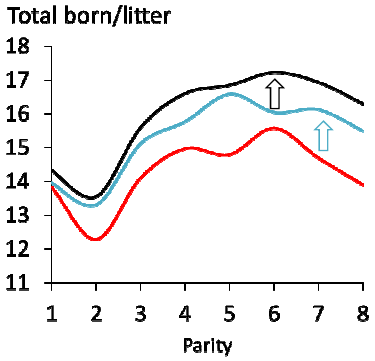
(1) since 1994

+26% total born + +43% losses = +23% weaned

1. GTTT-IFIP (French national database, fattening-growing units)

(2) Average relationships from sows born:

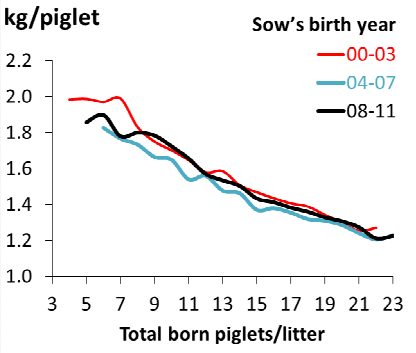
- from 2000 to 2003 (00-03)
- from 2004 to 2007 (04-07)
- from 2008 to 2011 (08-11)



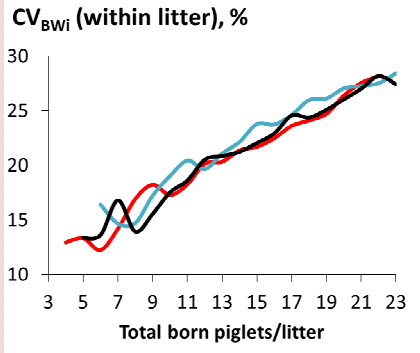
2. LWxLD sows, IFIP experimental station (Romillé), at least 10 litters per litter size x generation (4 years)

Prolificacy and birthweight (BWi)
average and coefficient of variation (CV)

↗ litter size
= decreased average birthweight (BWi)



↗ litter size
= increased within litter variability



LWxLD sows, IFIP experimental station (Romillé), at least 10 litters per litter size x generation (4 years)

Prolificacy and birthweight changes over time
➔ toward different populations in the herd

Characteristics of the populations change with litter size (TB = total born)

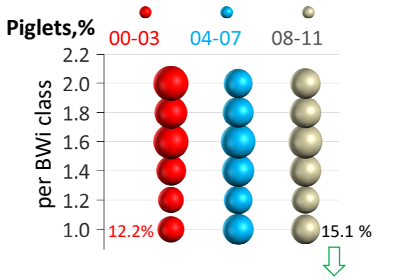
(consistently over time*)			
+1 TB ➲	+1 kg/litter	- 30/-40 g/piglet	+ 1 point CV_{BW0}

❶ population **of sows**

Litters, %	00-03	04-07	08-11
≤ 11 TB	22%	17%	14%
12-13 TB	17%	16%	12%
14-16 TB	36%	35%	34%
> 16 TB	25%	32%	40%

More large litters

❷ population **of piglets at birth**



More small piglets

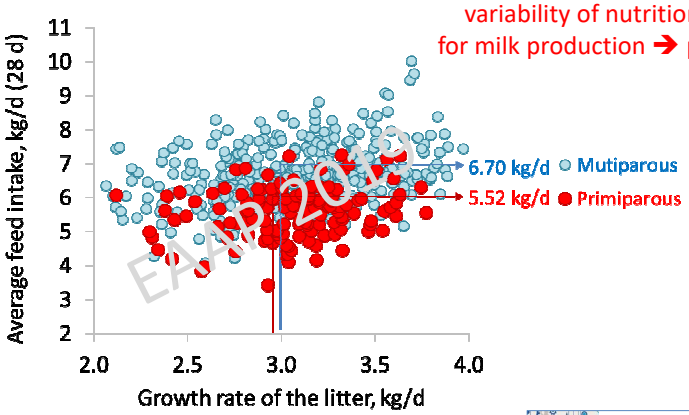
based on sows' birth year over 12 years

LWxLD sows, IFIP experimental station (Romillé), at least 10 litters per litter size x generation (4 years)

Management of a population of sows

1 herd = many sows with different parities, prolificacies, but also milk production level and appetite during lactation

variability of nutritional requirements for milk production ➔ precision feeding



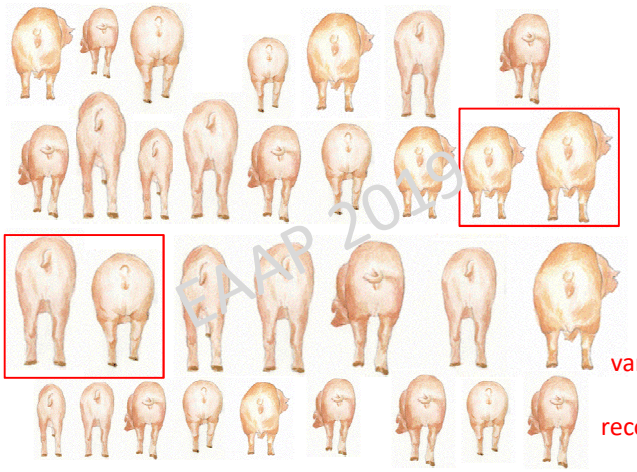
Quiniou (2016)

See R. Gauthier's presentation

Feed-a-Gene

Management of a population of sows

1 herd = many sows with different parities, prolificacies, but also milk production level and appetite during lactation



variability of nutritional balance (lactation)

⇩

variability of maternal tissue mobilisation

⇩

variability of body condition at weaning

⇩

variability of requirements for body condition recovering during gestation

Precision feeding of gestating sows

Backfat thickness at weaning ⇨ a single target value at farrowing

→ **3 mm** to recover → **10 kg** to recover + 15 kg growth

≠ amount of maternal reserves to recover
➔ ≠ nutritional requirements

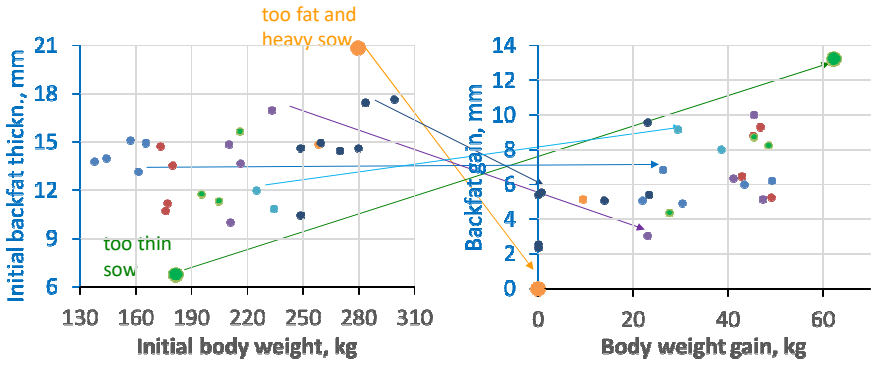
→ **12 mm** to recover → **60 kg** to recover + 15 kg growth

BW at weaning ⇨ target BW=f(age) at farrowing

Precision feeding of gestating sows

From highly variable initial characteristics
(28 sows from 1 batch at insemination)

➔ To expected **final BW** and **backfat thickness**
= depending on parity/age
= a single target adapted to the herd

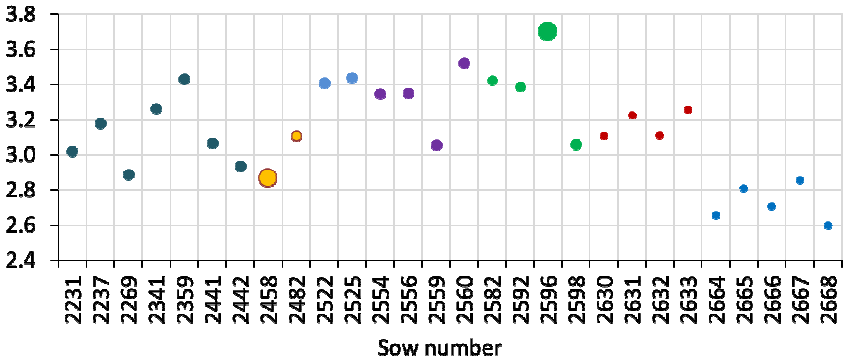


IFIP experimental station - batch 48.4 – insemination on March 20th 2017

Precision feeding of gestating sows

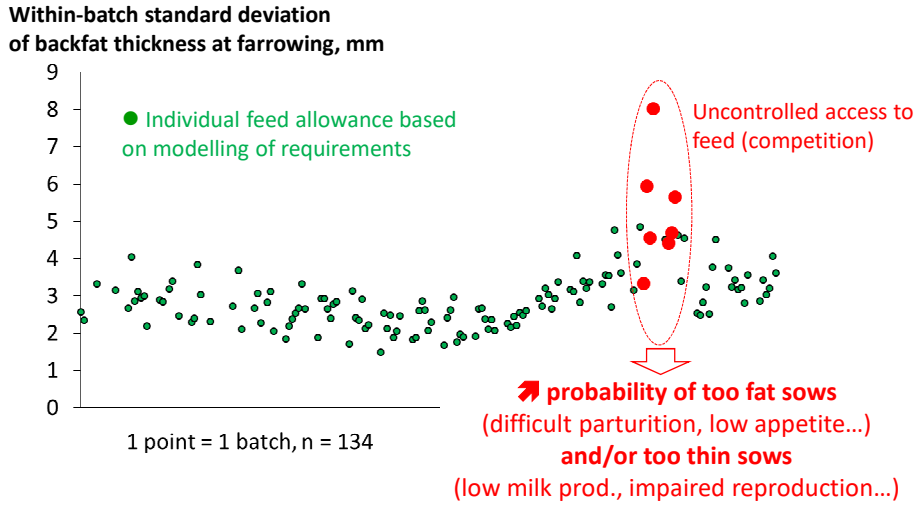
Average daily feed allowance* per sow from 1 batch over 115 d of gestation

InraPorc model



**calculated based on InraPorc model with a diet formulated on a 12.8 MJ ME/kg – 9.5 MJ NE/kg basis*
IFIP experimental station - batch 48.4 – insemination on March 20th 2017 – 7 h standing/d

Precision feeding (or not) and within-batch variability of backfat thickness (P2) at farrowing



Within each batch: 20 to 24 mixed parities LWxLD sows (Quiniou, 2016)

Management of populations of piglets

Characteristics of the populations change with litter size

❶ population **of sows**

Average TB/litter
14.0
15.3

x 1000 litters

+1300 piglets born

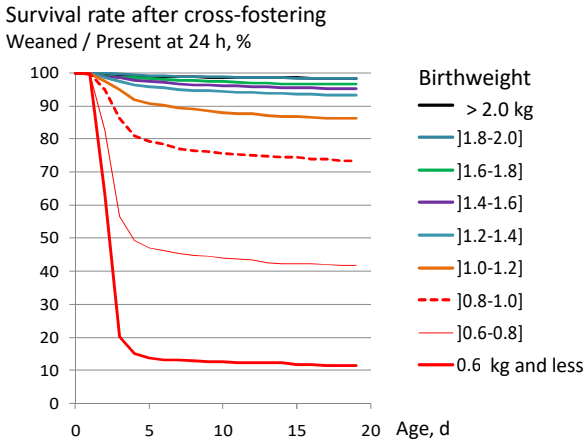
❷ population **of piglets at birth**

Number of piglets < 1 kg
12.2% → 1708 piglets
15.1% → 2310 piglets

+602 small piglets to manage

Birthweight (BWi) and survival rate

Low BWi = reduced survival rate after 7 d of age



Quiniou et al. (2002)

BWi and survival rate before weaning

Low BWi = reduced colostrum intake

Status / age	Dead ≤ 3 d	Dead > 4 d	Weaned
Birthweight, kg	1.02	1.31	1.40
Colostrum intake, g	72	219	326
Body T° at 24 h, °C	36.4	37.5	37.8
Immunoglobulin G, mg/ml	15.4	21.3	24.0

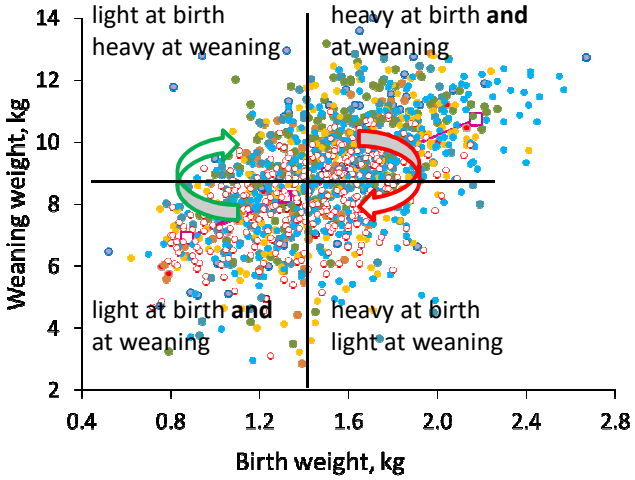
➔ specific care at birth is required to increase early survival rate of low BWi piglets

➔ specific nutrition of sows at particular period of gestation to reduce BWi variation

Devillers (2004)

Depending on the milk or feed intake…

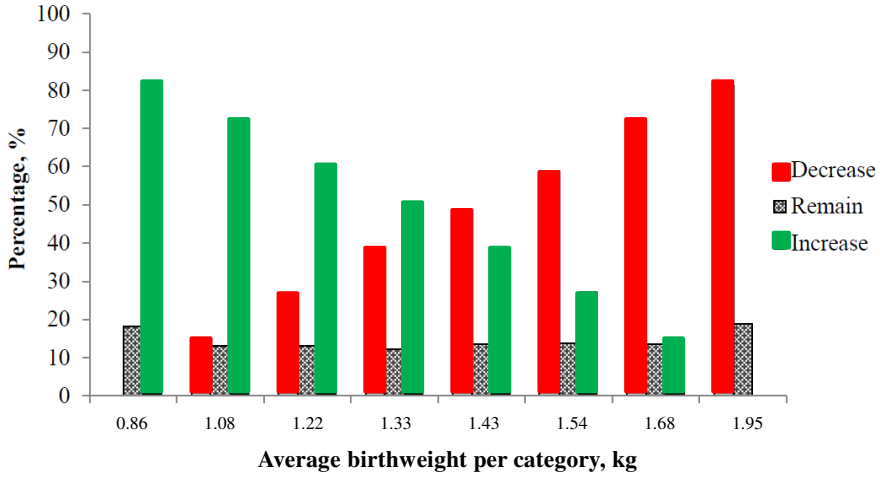
Some piglets switch from one BW class to another before weaning



Quiniou and Corrégé (2017)

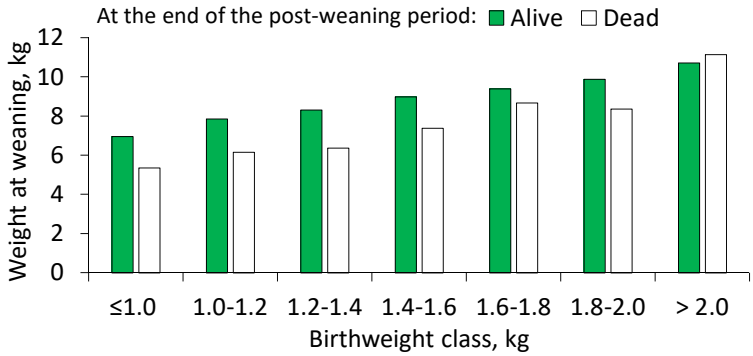
Depending on the milk or feed intake…

Piglets can switch from one BW class to another before weaning



(percentiles, Douglas et al., 2013)

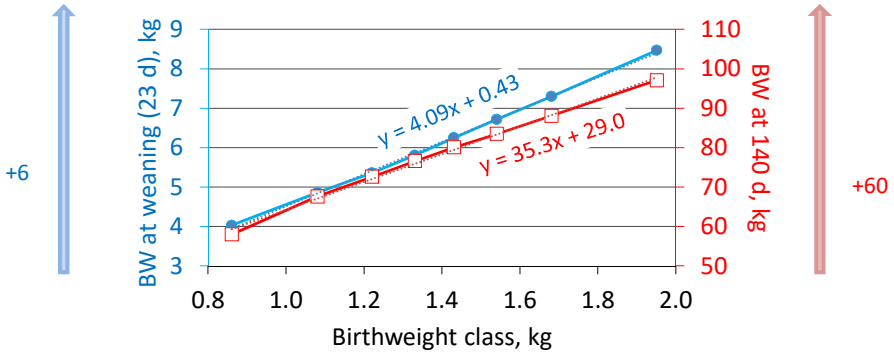
BWi and survival rate after weaning



➔ stimulate growth during lactation / nutrient intake (mainly milk)
- management of feeding strategy during gestation and lactation
- management of ambient temperature during lactation
- creep feed supply

Quiniou and Corrégé (2017)

BWi and variability of growth rate

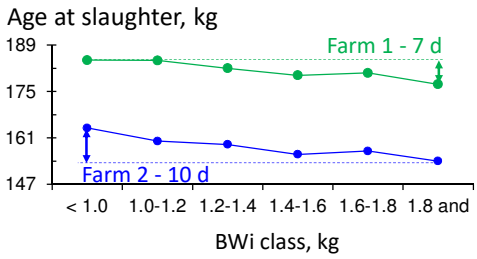


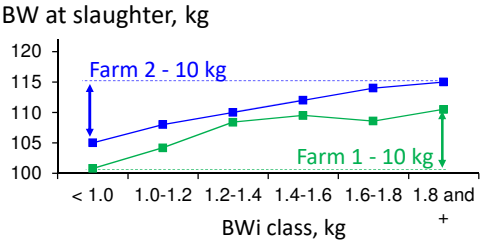
Farmers have to deal with an increasing difference in BW with age
➔ feeding strategy to meet nutrient requirement with the best efficiency
= precision feeding (pen, individual) ➔ environment, €

Douglas et al. (2013) – dataset 2

See C. Pomar's presentation

BWi and variability of age and BW at slaughter





all-in / all-out management (batches)

Max. occupation time / fattening rooms

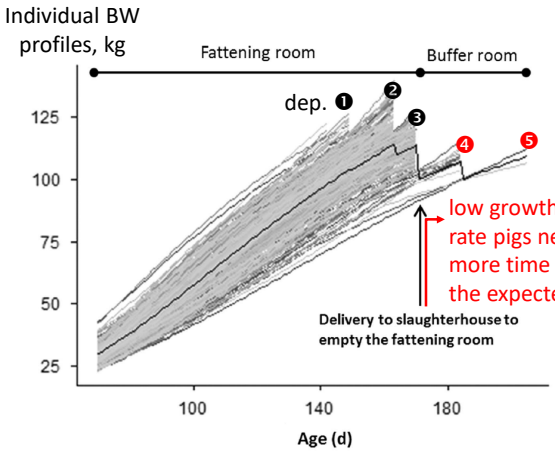
Management of deliveries to slaughterhouse

Carcass value (€)

Grid of payment (carcass weight)

IFIP-EDE (2004)

Management of pigs with different growth rates with or without a buffer room



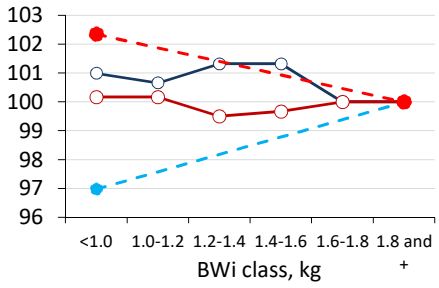
Pigs ❹	Buffer room Yes → No
Duration	-14 d
Final BW	-13.3 kg
Carcass, kg	-10.5 kg
Δ margin on feed cost, €/pig	-6.1 €

See also F. Leen's presentation

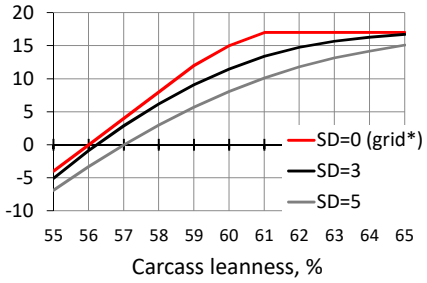
Cadero et al. (2017) Aubry et al. (2016)

BWi and variability of carcass leanness

Carcass leanness, %
(base 100 = heaviest piglets)



Extra money (due to leanness),
€/100 kg carcass



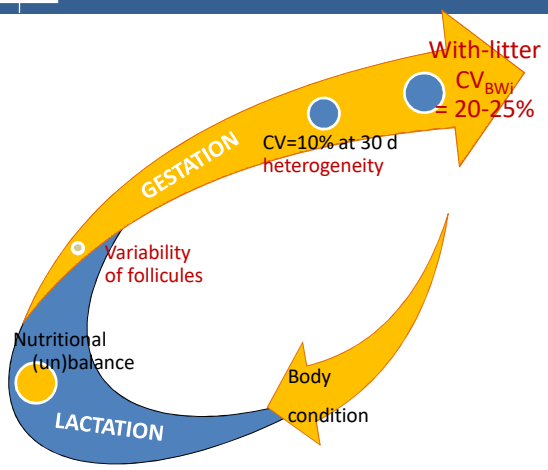
Ad libitum ≠ final BW — Restricted ≠ final BW
Ad libitum same BW — Restricted same BW

Body fat content depends on feeding level and spontaneous feed intake ⇨ Variability of leanness determines the extra income per carcass*

** French grid of payment (Quiniou et al., 2012), SD: standard deviation*
Quiniou et al. (2004), Le Cozler et al. (2004), Gondret et al. (2005, 2006)

See also F. Leen's presentation and P. Aymerich's presentation

Conclusion about variability on sows and piglets



Herd performance

Development of models, sensors, devices
➔ **precision farming**

A new way to consider variability
from inevitability (work, inefficiency, €)
to progress (welfare, environment, €…)

Updated abstract

EAAP Annual Meeting 2018, Dubrovnik, Croatia

Abstract title: Description and consequences of variability in sows and piglets
Author: Quiniou, N., Marcon, M., Salaün, Y., Dourmad, J.Y., Gondret, F., Quesnel, H., Van Milgen, J., Brossard, L.
Presentation: Theatre
Session 29: Variability in the pig production chain - problems and opportunities

Abstract text:

Even though animals are from the same genetic line, farmers have to cope with variability both in sows and piglets. In sows, variability is observed in traits such as parity, prolificacy, appetite, body weight (BW) and back fat thickness (BF). For instance, at the beginning of gestation, variability in body condition among sows can be high due to parity and age. In addition, at a given age, variability in litter size, milk potential, and appetite results in different nutrient requirements and consequently in variability of changes in maternal body reserves. Variability in BF can be a problem as several studies have indicated that too high or too low BF values are to be avoided at farrowing as well as at weaning. In both cases, the longevity of the sow is impaired, and farmers are advised to manage the sows toward a target BF depending on the physiological stage, associated with an age-dependant BW, increasing with age up to mature BW. In addition, variation in sow's body condition at farrowing and in prolificacy influences the new born and weaning piglet traits. Compared to less prolific sows, high-prolific sows farrow more piglets, which are both lighter on average and more heterogeneous. Compared to normal birthweight piglets, the survival rate of low birthweight piglets is lower. Providing additional care around birth helps these piglets to survive, but subsequent housing and feeding management have to be adapted to deal with the variability in their growth potential. Nutritional strategies (based on modelling approaches that take into account criteria that influence requirements) are suggested to optimise the expression of the animals' potential, but most often without an intention to reduce inter-individual variability in growth performance. In order to control or reduce variability, other solutions have been evaluated in experimental studies that focus on the level and the dynamic of the feeding plan and the quality of the diet. The challenge is now to validate these solutions in production units, which will be more or less easy depending on the existing housing and feeding systems, and the economic, welfare and environmental context. This study is part of the Feed-a-Gene project and received funding from the European Union's H2020 program under grant agreement no. 633531.