Relationship between growth parameters of heifers at various stages of rearing and milk production in first lactation

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Introduction

- ✓ Preweaning ADG is known to be especially important factor affecting future milk yield of heifers, at least in the 1st lactation (Soberon et al., 2012; Gelsinger et al., 2016; Chester-Jones et al., 2017).
- ✓ It is estimated that each additional 1 kg of ADG preweaning increases milk yield in the 1st lactation from 456 to 1113 kg (Soberon et al., 2012; Chester-Jones et al., 2017).
- ✓ In some studies relationship between preweaning ADG of heifers and milk yield in the 1st lactation was linear (Soberon et al., 2012).
- ✓ Results of those studies encourage for maximizing preweaning ADG of dairy heifers.

ADG = average daily gain

Introduction

On the other hand…

- ✓ Milk yield the in the 1st lactation was not further increased when ADG of calves exceeded 800 g/day (Chester-Jones et al., 2017).
- ✓ The linear relationship between preweaning ADG of calves and future milk production can be questioned from biological point of view.
- ✓ In some studies body weight of calves was shown to better predict milk yield of cows in first lactation than preweaning ADG (Chester-Jones et al., 2017).

ADG = average daily gain

Introduction

- ✓ Longevity of animals and life time production may be compromised when body weight of rearing heifers is maximized (Han et al., 2021).
- ✓ **Some studies suggest that not only preweaning but also postweaning ADG may have substantial impact on future milk yield of cows (Bach and Ahedo, 2008; Soberon et al., 2012).**

ADG = average daily gain

Research hypotheses

1. The relationship between ADG of heifers and future milk production is not linear, at least not at all stages of rearing.

2. Future milk production is not only affected by preweaning ADG of heifers but also postweaning ADG.

3. Future milk production is affected not only by ADG but also BW of heifers and optimal BW of heifers may differ depending on the phase of rearing.

ADG = average daily gain, BW = body weight

Aim of the study

The aim of the study was to determine relationships between the rearing parameters of dairy heifers (body weight and average daily gain) and the milk yield in 1^{st}, and also 2^{nd} lactation.

Materials and methods

- ✓ Data of body weight of heifers and 1st and 2nd lactation details were received from one dairy operator: Ośrodek Hodowli Zarodowej Osięciny sp. z o.o. (Kuyavian-Pomeranian Voivodeship of Poland).
- ✓ The database included 2765 indyvidual animals of which 1768 met all criteria and were used for further analysis.
- ✓ The dabase included folowing growth traits:
  - Birth body weight,
  - Weaning body weight,
  - Body weight at 6 months,
  - Body weight at 12 months,
  - Body weight at breeding.

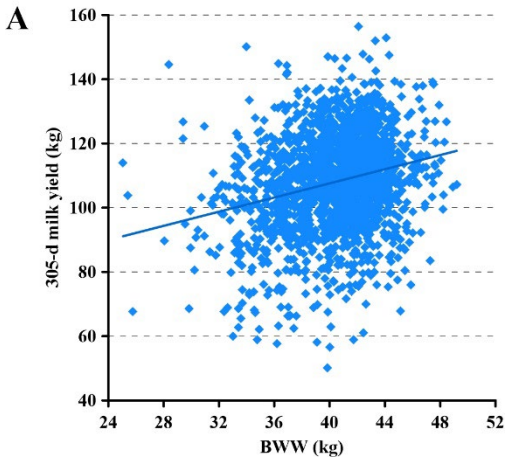
Materials and methods

- ✓ Data processing and data analysis:
  - ✓ To estimate BW at specific life stages (day 60, 180, 360, and 410) Legendre polynomials were used,
  - ✓ BWs at sepcyfic days of age were subsequently used to calculate ADG,
  - ✓ Genetic effects were removed from the dataset to focus conclusions on environmental factors,
  - ✓ Linear and quadratic regression were used to analyze the dataset.
- ✓ The SAS system (version 9.4) was used for all data analysis.

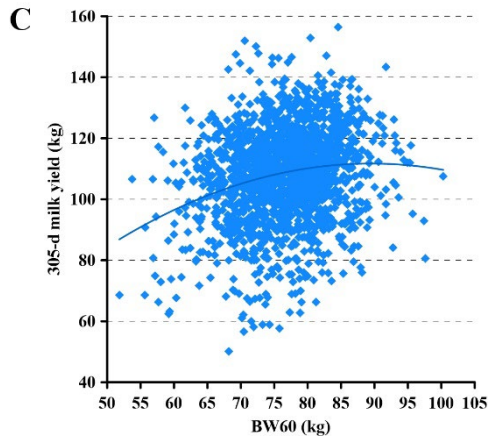
BW = body weight, ADG = average daily gain

Results

1st lactation

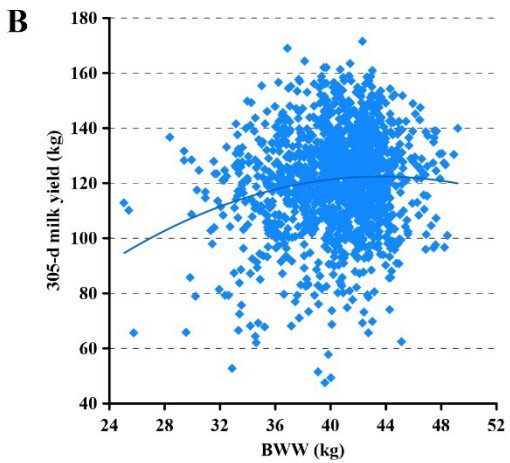


$P_L < 0.0001$

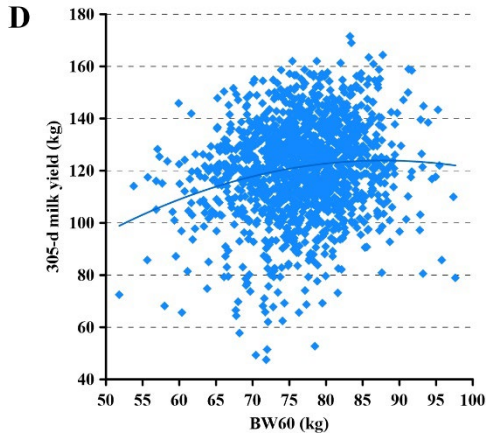


$P_Q < 0.0011$

2nd lactation



$P_Q < 0.0001$



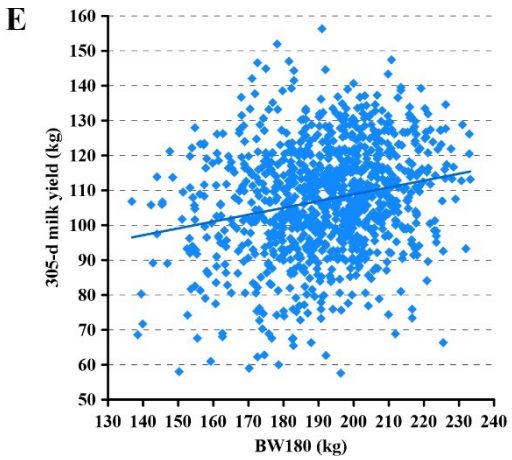
$P_Q < 0.0001$

Relationship between birth BW (BBW) and 305-d milk yield in 1st (**A**) and 2nd lactation (**B**), and BW at 60 days of age (BW60) and 305-d milk yield in 1st (**C**) and 2nd lactation (**D**)

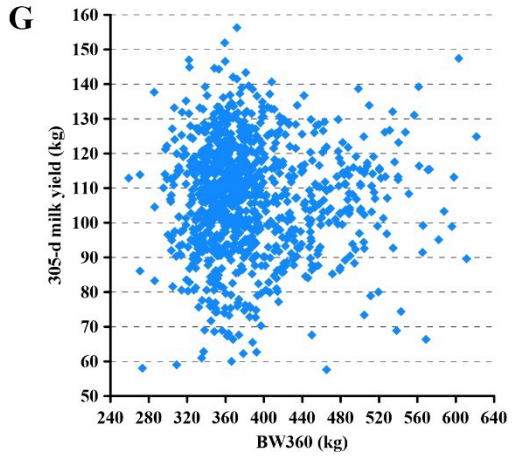
BW = body weight, P_L = *P*-value for linear regression, P_Q = *P*-value for quadratic regression

Results

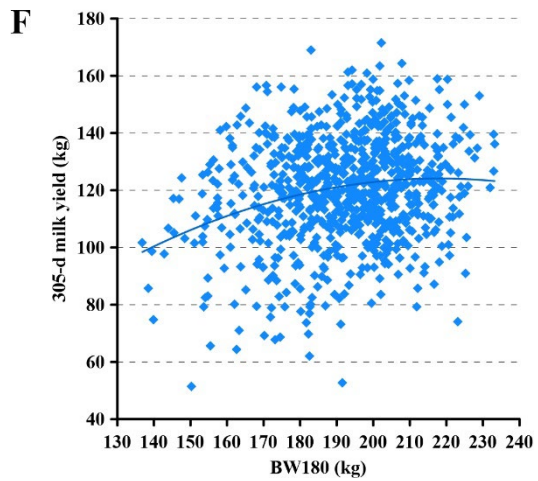
1st lactation



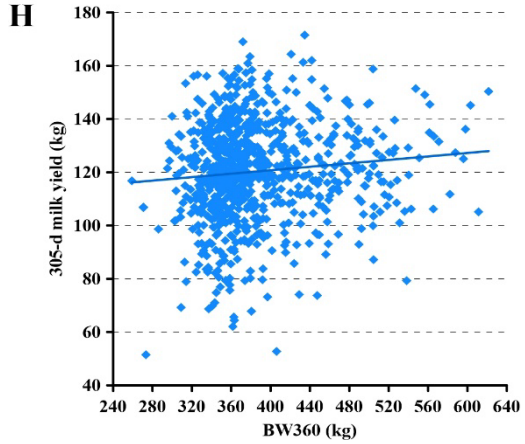
$P_L < 0.0001$



2nd lactation



$P_Q < 0.0001$



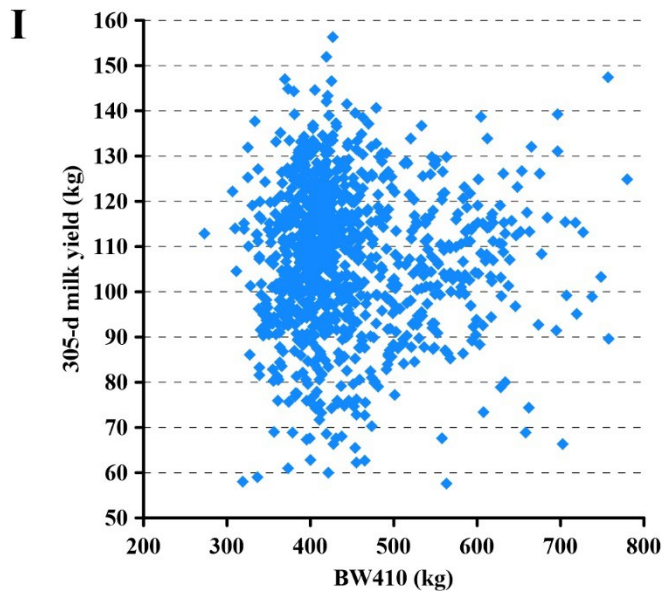
$P_L = 0.0167$

Relationship between BW at 180 days of age (BW180) and 305-d milk yield in 1st (**E**) and in 2nd lactation (**F**), and between BW at 360 days of age (BW360) and 305-d milk yield in 1st (**G**) and in 2nd lactation (**H**)

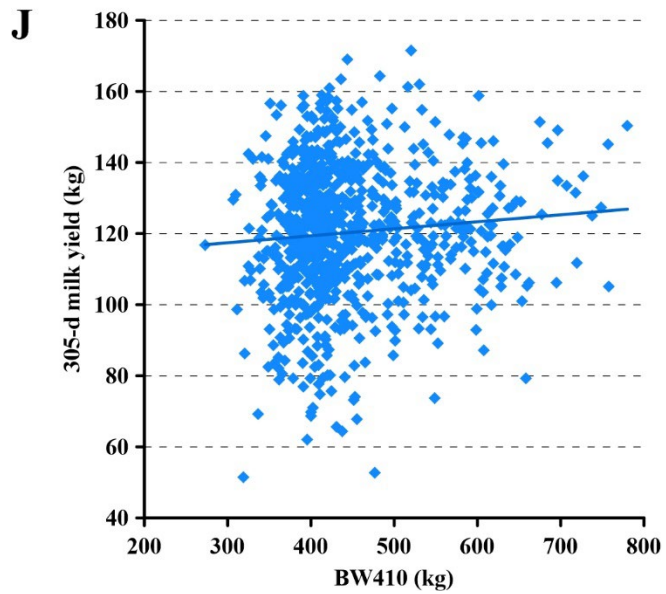
BW = body weight, P_L = *P*-value for linear regression, P_Q = *P*-value for quadratic regression

Results

1st lactation



2nd lactation



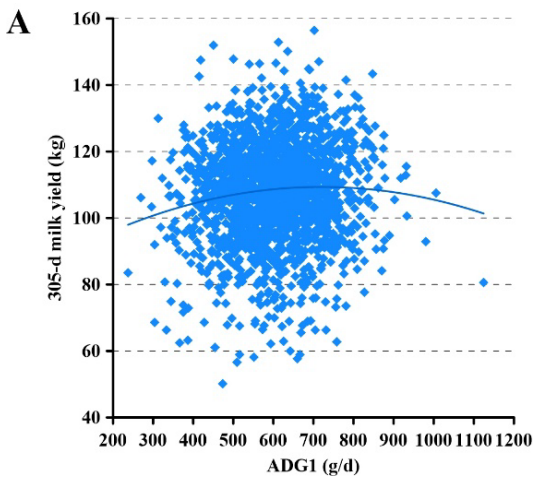
P_L = 0.0482

Relationship between BW at 410 days of age (BW410) and 305-d milk yield in 1st (**I**) and in 2nd (**J**) lactation

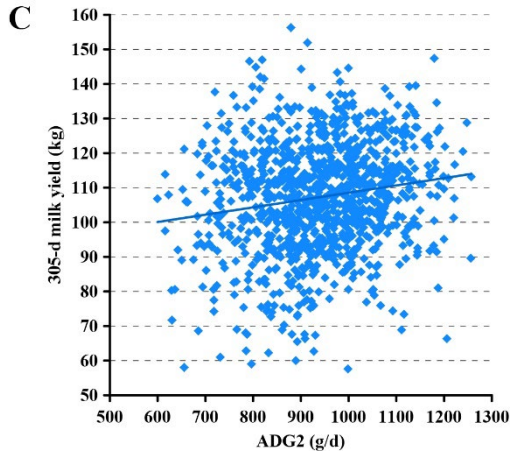
BW = body weight, P_L = *P*-value for linear regression

Results

1st lactation

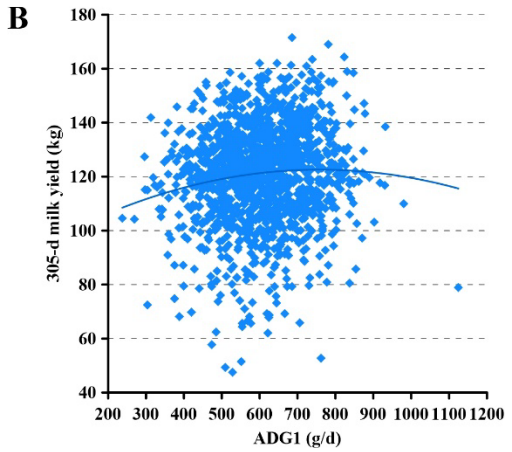


$P_Q < 0.0001$

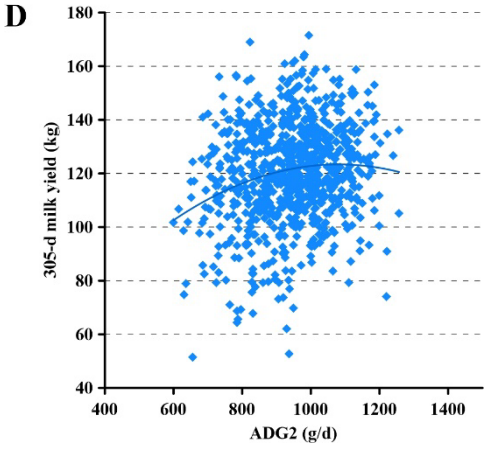


$P_L < 0.0001$

2nd lactation



$P_Q = 0.0035$



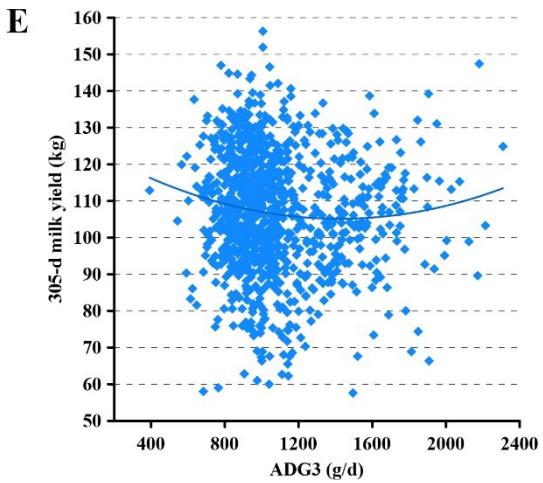
$P_Q < 0.0001$

Relationship between ADG from birth to 60 days of age (ADG1) and 305-d milk yield in 1st (**A**) and in 2nd lactation (**B**), and between ADG from 60 days of age to180 days of age (ADG2) and 305-d milk yield in 1st (**C**) and in 2nd lactation (**D**)

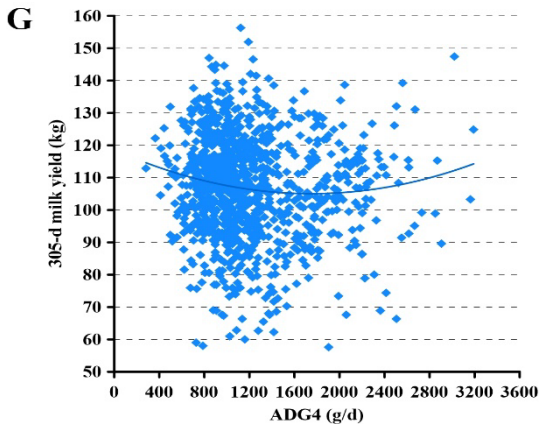
ADG = average daily gain, P_L = *P*-value for linear regression, P_Q = *P*-value for quadratic regression

Results

1st lactation

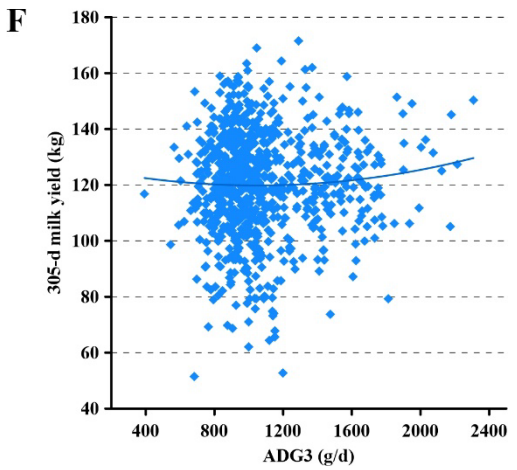


P_Q = 0.0214

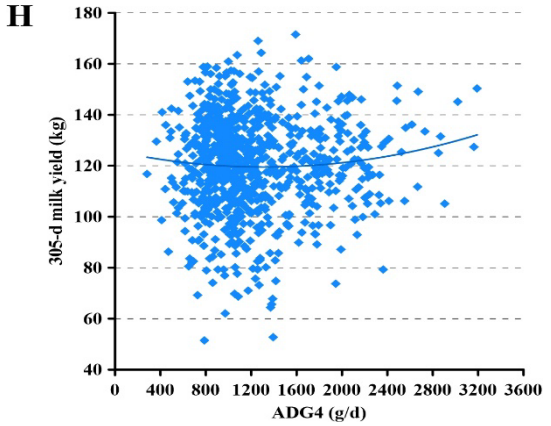


P_Q = 0.0076

2nd lactation



P_Q = 0.0608



P_Q 0.0129

Relationship between ADG from 180 days of age to 360 days of age (ADG3) and 305-d milk yield in 1st (**E**) and in 2nd lactation (**F**), and between ADG from 360 days of age to 410 days of age (ADG4) and 305-d milk yield in 1st (**G**) and in 2nd lactation (**H**)

ADG = average daily gain, P_Q = *P*-value for quadratic regression

Conclusions

- ✓ The milk yield of heifers is affected by BW and ADG during both the preweaning and postweaning phases of rearing.
- ✓ The relationship between BW and future milk yield as well as between ADG and future milk yield varies depending on the stage of rearing and can be either linear or quadratic and both positive and negative.
- ✓ Of investigated factors, birth BW and BW at 6 months of age had a postive linear relationship with milk yield during 1st lactation.
- ✓ Preweaning ADG > 800 g/day was associated with a reduced milk yield across both the1st and 2nd lactation.
- ✓ The milk yield in 1st and 2nd lactation decreased quadratically with increasing ADG between 6 month of age to breeding.

BW = body weight, ADG = average daily gain

Thank You

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