Estimated output from assisted reproductive techniques (OPU/IVF) in Holstein cattle associated with the genetic background

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Session 41. Optimising reproductive physiology of livestock

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Introduction

- Reproduction technologies are a central element of breeding scheme efficiency.
- Since 2015 **gEBV** (and candidate gene information) are used within our breeding scheme to assess **MOET productivity** of donors.
- Over the last years, **OPU/IFV** became the **predominant** reproduction technology.
- **Objective:** Assess the genetic contribution to productivity in order to adapt consequently the breeding scheme decision and improve our production process.

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Material & Methods

Data

- SYNETICS **donor stud Nückel**, Northwest Germany
- OPU/IVF results from April 2018 – August 2023
- **9,099** sessions performed
- **1,596** Holstein donors originating from 254 farms
- 336 different sires of sons used for fertilization

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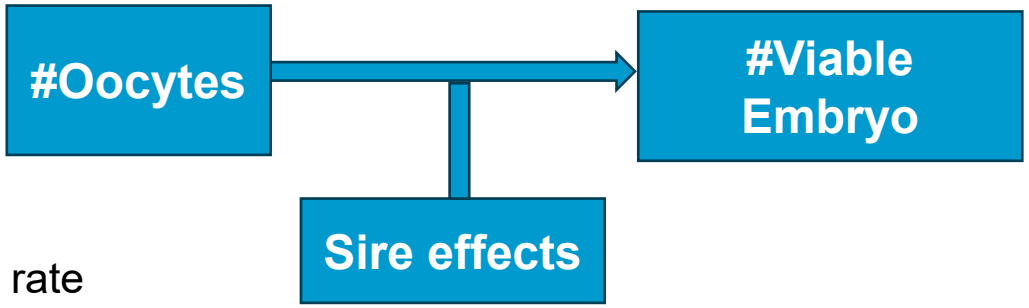
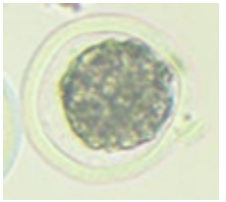
Model building



- Phenotypes
  - Number of oocytes, number of viable embryos, development rate
  - Transformation of the traits or not?
- Effects taken into account
  - Season, Year, Age Group, OPU Rank, Day of production, Semen sexed or not, HH1 risk mating, Donor, Sire of embryo…
  - Type of the effect fix, Random, genetic?
- Model
  - Linear model
  - Threshold model



Assess the model that best fit data at hand while being sound

Results 1: Model

- Final models

$$\#OOcyte = \mu + year + season + age\ group + env_{perm} + animal + day + OPU\ rank$$
$$\#Viable\ Embryo = \mu + year + season + age\ group + env_{perm} + animal + day + embryo\ sire + semen\ type$$
$$Devpt\ Rate = \mu + year + season + age\ group + env_{perm} + animal + day + embryo\ sire + semen\ type + NRH_{GEBV}$$

- Similar effects retained within traits, among which donor's genetic effects ☑
- Expected effect of the semen for traits related to embryo ☑
- Some effects needing more investigations ☒

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Results 2: Genetic parameters

- Highest estimates of genetic parameters :

	Number of oocytes	Viable embryos	Development rate
Data transformation	Anscombe	None	None
heritability	0.24	0.13	0.09
repeatability	0.36	0.20	0.13

➔Simpler traits lead to more satisfactory results

➔Additionnal data may be needed to handle more complex traits (or transformed one)

➔Heritability remain promising owing to the control environment of donors barn

➔Despite these caveats gEBV can be obtained for candidate to donors station (predictive ability ranging from 0,27-0,14)

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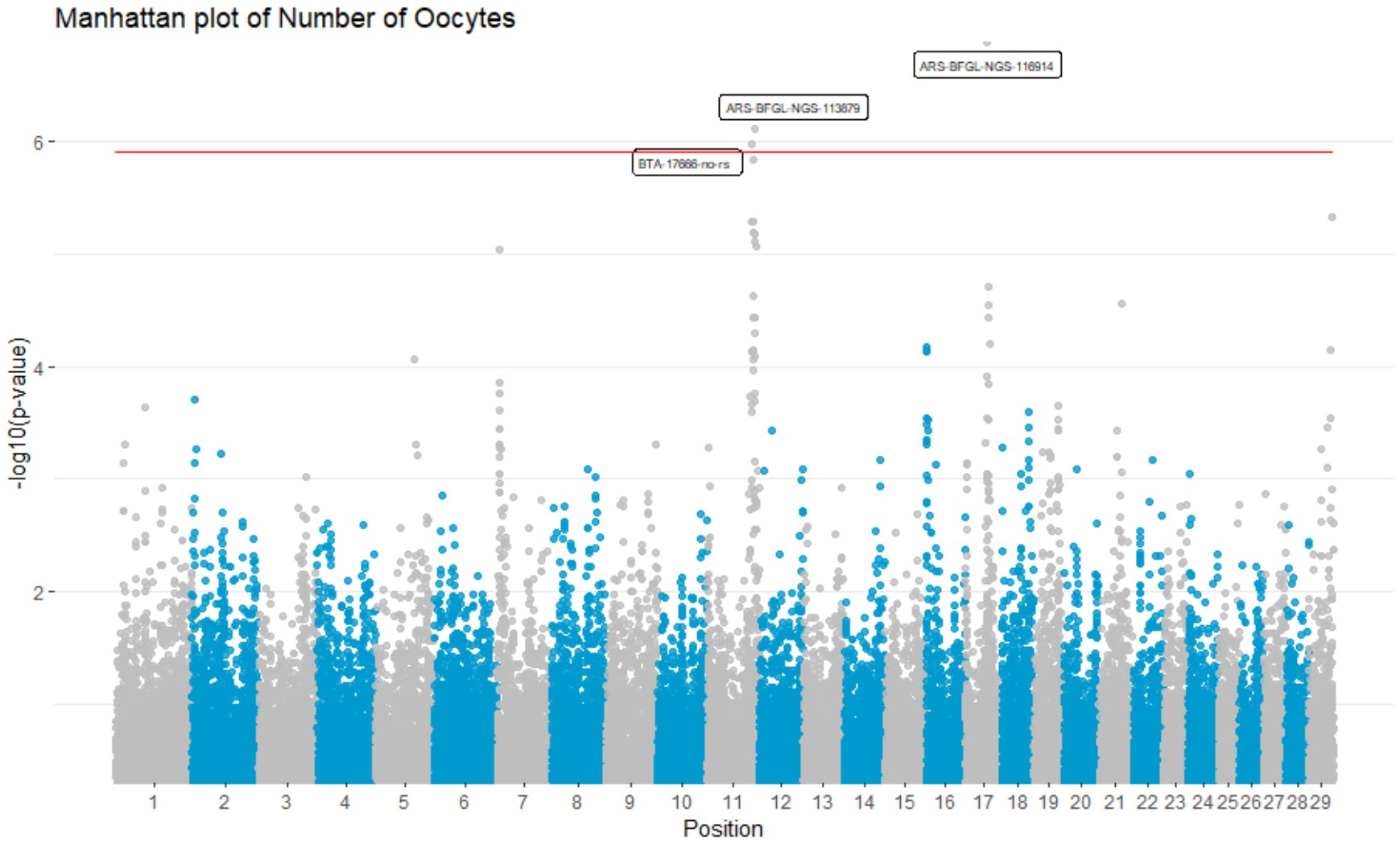
Results 3: First insight from GWAS



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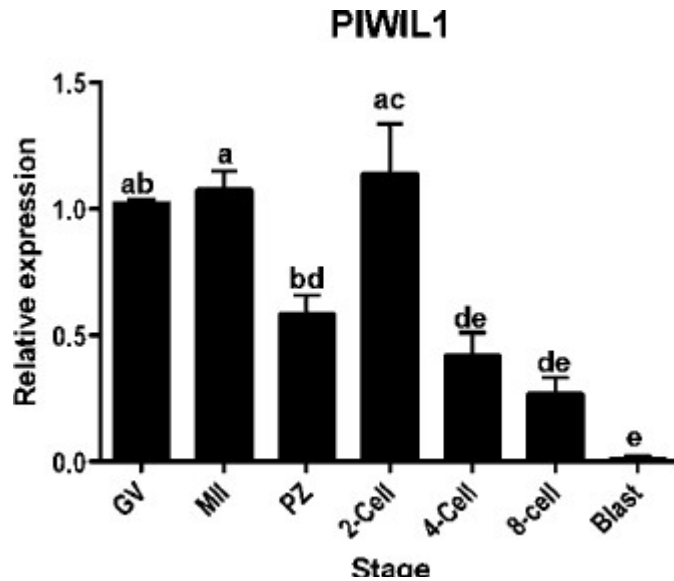
Results 4: First insight from GWAS

- PPP6C (BTA11): Protein Phosphatase 6 Protects Prophase I-Arrested Oocytes by Safeguarding Genomic Integrity (Hu et al., 2016)
- ANGPTL2 (BTA11): Aberrant expression of angiopoietin-like proteins 1 and 2 in cumulus cells is potentially associated with impaired oocyte developmental competence in polycystic ovary syndrome (Liu et al., 2016)
- ADGRD1 (BTA17): Control of oviductal fluid flow by the G-protein coupled receptor Adgrd1 is essential for murine embryo transit (Bianchi et al., 2021)
- PIWIL1 (BTA17): Production of functional oocytes requires maternally expressed PIWI genes and piRNAs in golden hamsters (Hasuwa et al., 2021)

➔Additional data, models adaptation and sequence data will help to refine genetic architecture behind these QTL



PIWIL1 expression during oocyte maturation and embryogenesis.(Russel *et al.*,2016)

Conclusion and perspectives

- **A First promising work on OPU/IFV**
  - Simpler traits (Number of oocyte) already offer interesting results
  - Continuous data collection will improve our understanding of key gene in the OPU/IVF production by use of finer model
  - In house gEBV are already available for some first test

- **2 QTL found on BTA17 and BTA11**
  - Literature review identify candidate gene
  - Additional investigations will allow to refine the list of candidate gene

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The Perfect Fit

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