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A Novel QTL is Associated with the Progressive Motility of Franches-Montagnes Stallion Spermatozoa after Thaw

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The Franches-Montagnes breed

- The Franches-Montagnes (FM) is the last native Swiss horse breed with multiple use and good character

- Today, the FM is a light draught breed that excels in leisure riding and in international driving competitions

https://www.lenouvelliste.ch/articles/sports/autres-sports/jerome-voutaz-721679

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FM breeding in Switzerland

- Roughly 1800 foals born each year
- Approximately 240 available stallions (living or AI)
- Number of foals per stallion and season vary from 0 to 48

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FM breeding in Switzerland

- Still very traditional, not highly professionalised
- Many breeders have mostly 1-2 broodmares
- Natural cover is more common than AI
- AI important for breed conservation

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Methods - phenotypes

- Sperm quality parameters of 109 FM stallions tested in Avenches between 1993-2021

- Parameters
  - Gel-free volume (VOL)
  - Concentration (CON)
  - Total sperm count (TSC)
  - Progressive motility (PM)
  - Progressive motility after thaw (PMAT)

- Phenotype filtering
  - Outliers out, one month of the most recent sampling year

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Methods – genotypes and GWAS

- **Genotypes**
  - 59 stallions on the AxiomTM Equine Genotyping Array (670K)
  - 3 stallions with WGS (min 10x coverage)
  - 47 stallions with imputed sequence-level genotypes

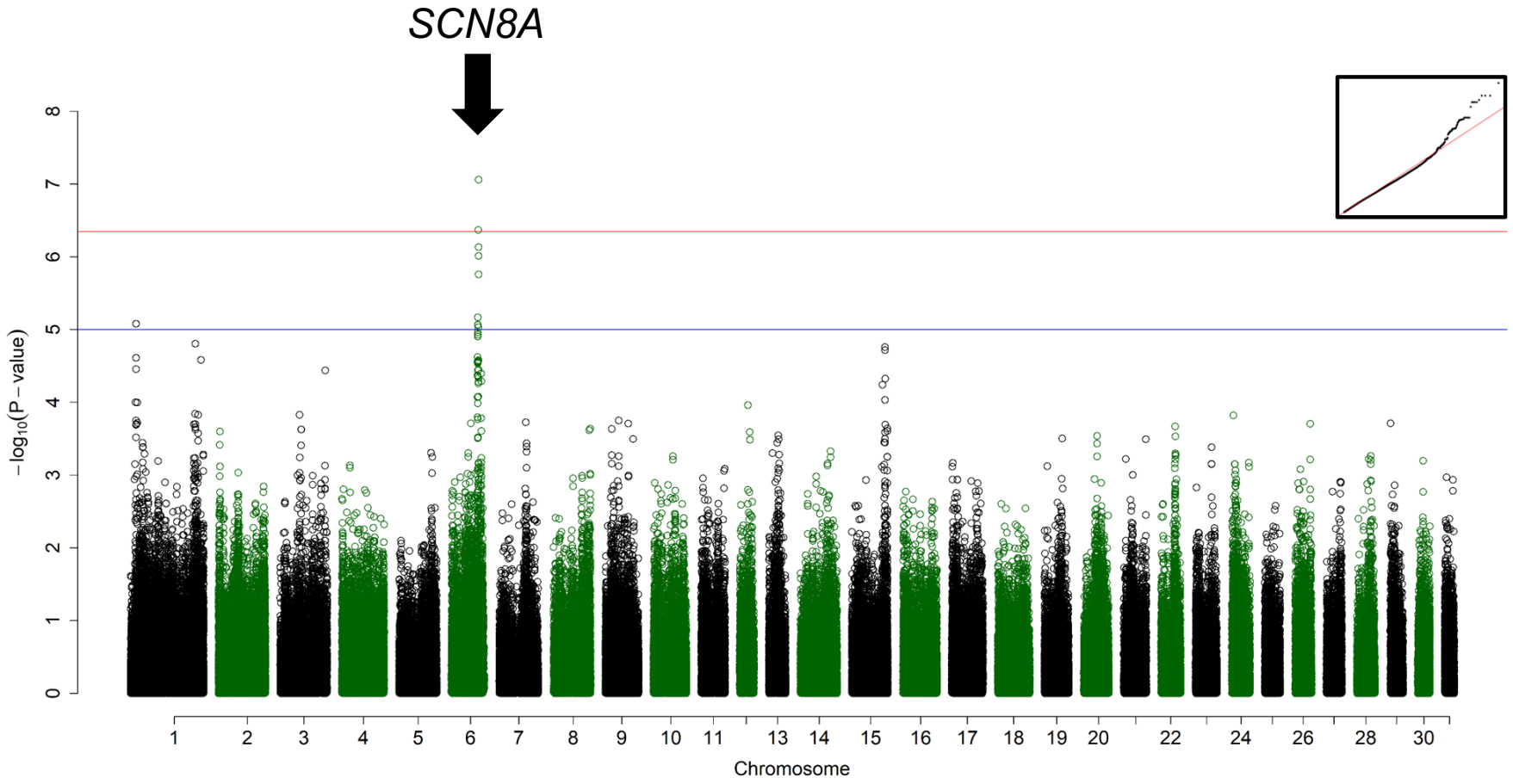
  ➢479,600 SNPs

- **Filtering** PLINK: --maf 0.05, --geno 0.10, --hwe 0.0001

  ➢335,494 SNPs for GWAS

- **Polygenic model** with significant fixed effects ($p < 0.05$)
  - age at sampling, month of sampling and year of sampling

Significant QTL for PMAT



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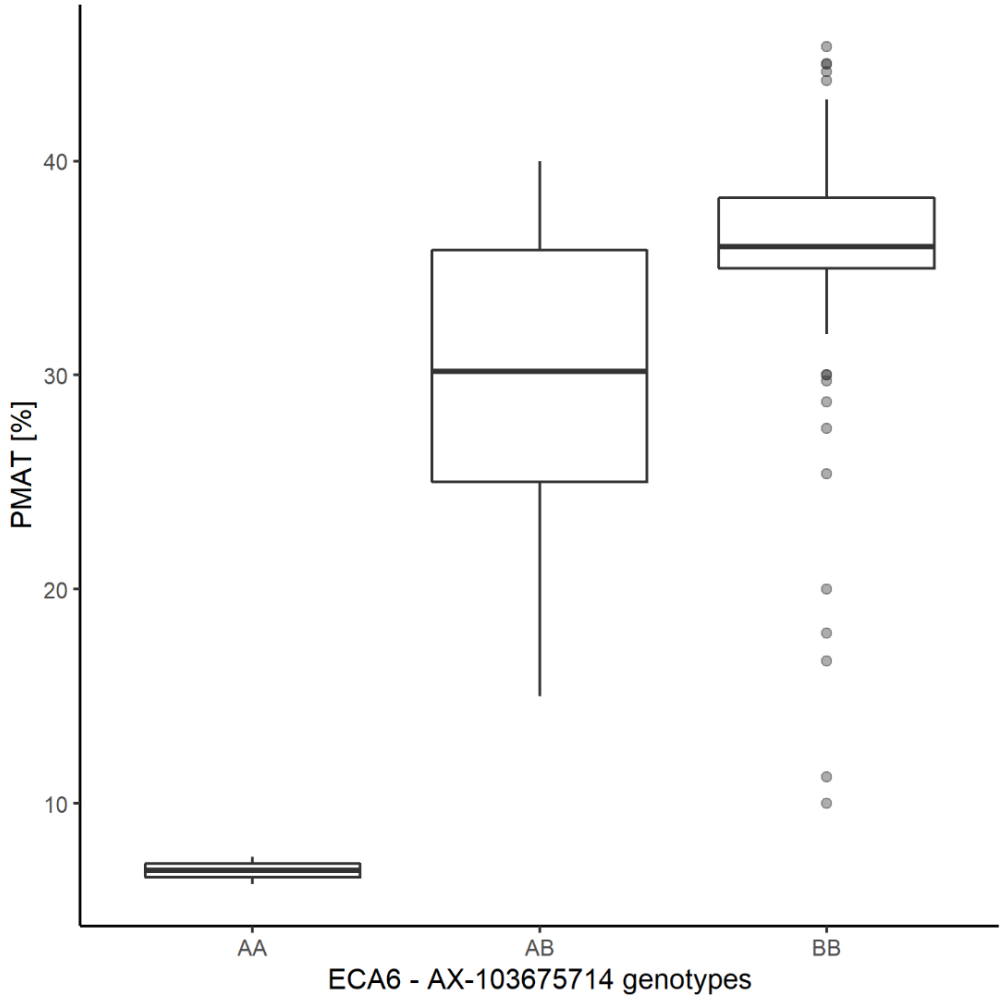
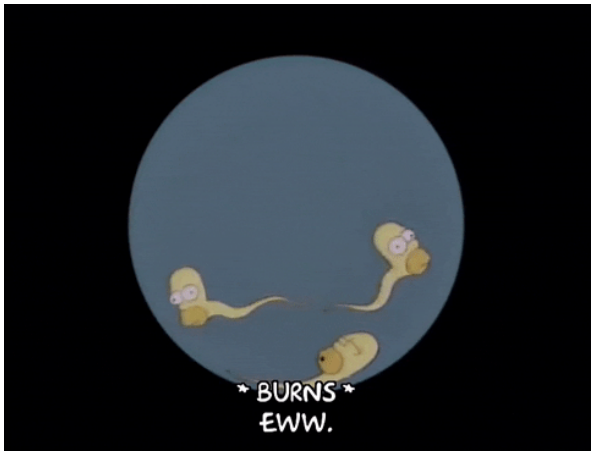
Effect of the significant QTL on PMAT





Industry requirement:
PMAT > 35%

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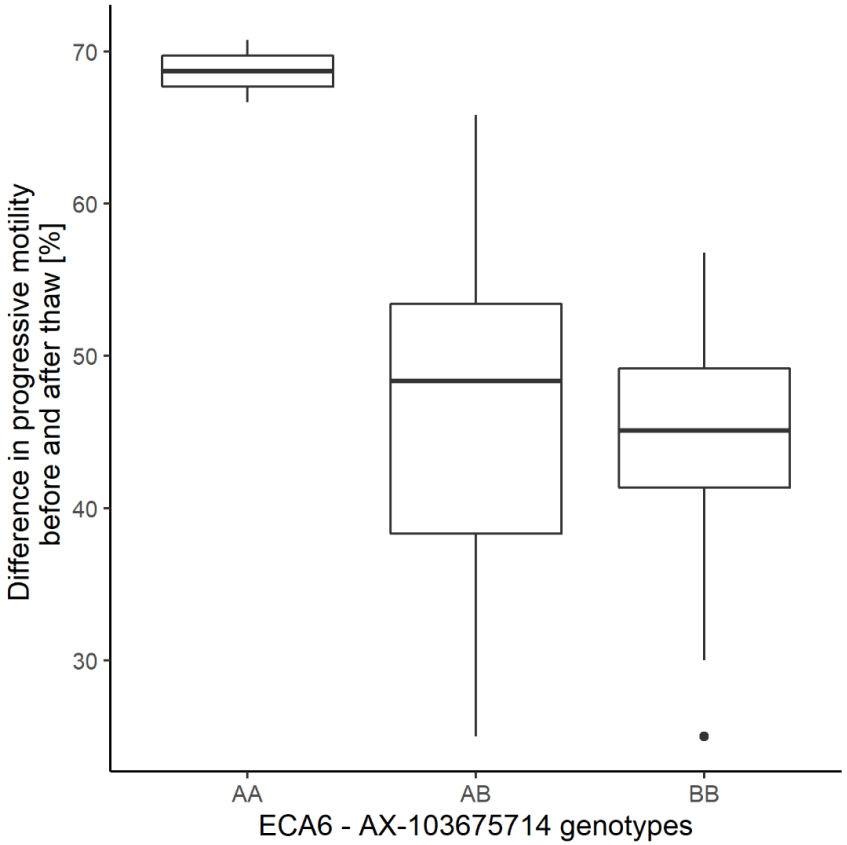
Effect of the significant QTL

- Decrease between PM and PMAT in all horses
- Strong decrease in PMAT, with initial high PM
- Homozygous AA stallion with > 300 descendants



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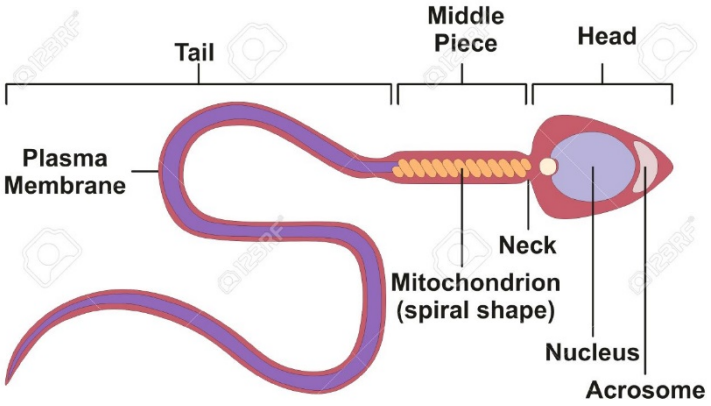
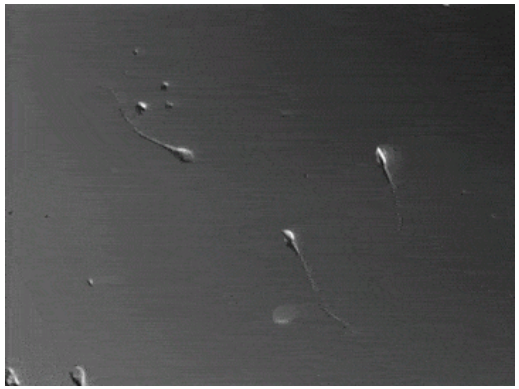
SCN8A gene

- Sodium Voltage-Gated Channel Alpha Subunit 8 is present in the flagellum and around the neck of mammalian spermatozoa, involved in motility (Pinto et al. 2009)





- QTL in the *SCN8A* gene associated with motility and progressive motility in fresh semen of boars (Marques et al. 2018)

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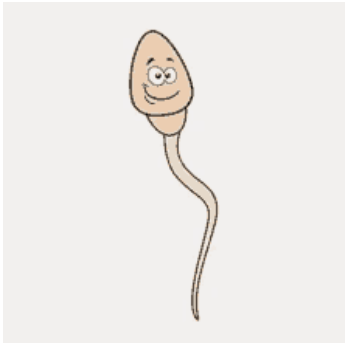
Implications for equine breeding

- In the FM, this QTL is only associated with PMAT, not PM

https://www.westvets.com.au/artificial-insemination/

- Pre-screening of stallions may be useful to avoid costs for predictably unsuccessful cryoconservation in homozygous stallions

- Because FM are bred using mostly natural cover, the QTL is less relevant for reproductive capacity than in other breeds



- Further studies should confirm this QTL in other breeds, especially Warmblood horses

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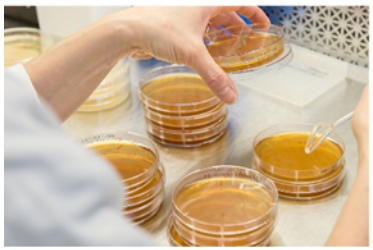

Thank you for your attention

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