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Development of genomic tools for horses and their potential impact on the equine sector

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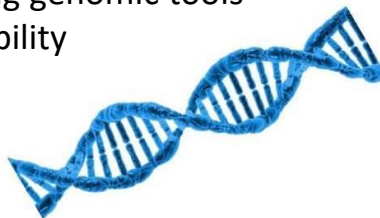
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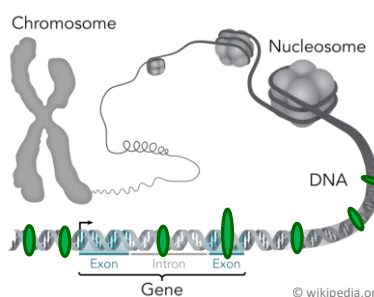
Outline

- ❖ Why are equine genomics a field of great potential?
- ❖ What makes the conditions today very good to catch up and implement genomic tools for horses?
- ❖ How can the interest in using genomic tools and their increasing accessibility impact the equine sector?



Why genomics?

- genomic data = information on the whole genome, e.g. by genome-wide markers, most often single nucleotide polymorphisms (SNPs)
- **getting the big picture** ('genetic fingerprint') rather than reading a few markers of known relevance (trait-associated or causal markers)



Why genomics?

- genomic data = information on the whole genome, e.g. by genome-wide markers, most often single nucleotide polymorphisms (SNPs)
- **getting the big picture** ('genetic fingerprint') rather than reading a few markers of known relevance (trait-associated or causal markers)
- refined individual genetic characterization and corresponding reflection of genetic (dis-)similarities between individuals
- replacement of pedigree relationship by genomic relationship matrix implying **possible gain in reliability and time** in genomic systems when compared to conventional genetic evaluation

Why genomics especially in horses?

- benefit of genomic approaches particularly high for:
 - traits with low heritabilities (large amounts of data needed for reliable conventional systems and individual genetic proofs)
 - challenging traits due to limited availability of phenotypic data (difficult or expensive to record, late phenotypic expression)
 - species with long generation interval
- demonstrated in dairy cattle breeding
- **similar or even higher potential of improvements through genomic approaches in horse breeding**

Conditions of genomic development I

- basic information on the equine genome
 - 'The Horse Genome Project' (1995-2007)
 - EquCab2.0 (since 2007)
 - SNP library, 50k SNP chip, ...
 - EquCab3.0 (since 2018)
- expertise and substantial experience from other species
 - crucial factors for successful system development
 - technical pitfalls and possible solutions for challenging settings
 - methodology for estimation, validation, calibration
 - infrastructural needs for routine implementation

*"You can't use an old map to explore a new world."
Albert Einstein.*

Conditions of genomic development II

- technological development + supply and demand mechanisms
 - SNP genotyping as routine service of many laboratory service providers
 - enormous price reduction (costs per SNP ↓↓)
- change of mind
 - from: long time of relatively slow adoption of the new tools in horses (few active research groups, skepticism of the practice)
 - to: growing interest of the equine sector in adopting genomic selection (convincing evidence for the effectiveness of genomically enhanced breeding applications)
- engagement of the practice in equine genomic development

Application-oriented development

- expectation of the practice: all-in-one solution
 - **direct usability** rather than prolonged pure research investments
 - **single analysis** in the molecular genetic laboratory giving access to (much) more information than former routine testing
 - replacement of single-purpose genetic markers for parentage control (short tandem repeats, STRs) by **multi-purpose SNP technology**
 - no or less distinct gene tests required for special traits (patents / intellectual property rights)

- optimized genomic tools and applications through close collaboration of science and practice (end-users, analysts, manufacturers)

Challenges & opportunities

- limited resources of individual studbooks and organizations, but considerable overlap of breeding goals and wishes / expectations regarding the future use of genomics in horses
- often limited direct accessibility of genomic tools (SNP genotyping, data management and use), but existing networks, interdisciplinary initiatives and openness to share experiences, ...
- synergy potential of **collaboration** of several studbooks with experienced partners (R&D, logistics, data interpretation)
- valid future model through **clear and agreed targets**: routine applications to strengthen the equine sector

Potential impact on the equine sector

- joint interest in making genomic tools available for the equine sector as motivation to intensify **collaboration within the sector**
 - across countries and studbooks
 - across parts of the equine sector (riding, racing, special breeds, ...)
- new consortia as possible drivers of innovation in the field of genomics (enabling the sector)
- **competition not in access to, but in the use of genomic tools (services)**



Prospects

- benefit of a widely usable and used all-in-one solution, e.g. SNP chip
 - breeding / studbooks: more horses with genome wide SNPs = broad basis for population screening, breed management, genomic selection
 - attractive solution also for individual breeders; gain for science
 - joining forces and using synergies all along the line (incl. required support of appropriate use of the new tools)
- continued development of genomic tools (routine and research use)
 - marker performance based on practical experiences
 - overall coverage (genome; traits) accounting for new findings and uses
- common interest of the equine community → invitation to contribute



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- increase of international and interdisciplinary collaboration
- new consortia as possible drivers of innovation in the field of genomics (enabling the sector)
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Thank you !