State of Research and Development in Cattle

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The Impact of Gene Technology in Animal Agriculture and Food Production
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Outline of the presentation

• The “delivery” system to industry.

• Methodologies that being applied in cattle.

• Considerations for the trait selection.

• Some examples.
Combining biotechnologies

• Reproduction
• Genomics
Reproductive biotechnology

- Artificial insemination
  - Fixed-time artificial insemination
  - *In vitro* fertilization, embryo transfer
  - Cloning

Advanced genomics

- Genomic estimated breeding values
- Embryo genotyping
- Gene editing
- Pluripotent cells transfer

Well established technologies
- Used to multiply desired animals

Mixed developmental stages
- Some ready, some need refinement
Methodologies for gene editing in livestock
Cell editing + cloning + embryo transfer

Isolate somatic cells
Gene editing cells
Screen/selection of cells
Cell cloning + embryo transfer

The genetic modification is fully monitored – low efficiency in generating offspring
Zygote injection + embryo transfer

Zygote electroporation + embryo transfer

High efficiency in generating offsprings – not so controlled gene editing
Embryo screening before transfer

Adding “monitoring” of gene editing

Vitrification of biopsied blastocyst

DNA analysis
Trait selection and examples
Trait selection – decision tree

1. What is the industry problem?
2. Welfare, Health, Environment, Productivity
3. Gene or variant already identified?
4. Complexity of gene editing
5. Is it a GM solution?
6. Can we scale up?
Some trait examples

**Coat colour**

- MC1R
  - E/e

- PMEL
  - WT/del

- Acceligen

**Coat type**

- PRLR
  - Several mutations

- Littlejohn et al. 2014 Nat Commun. 18;5:5861
- Porto-Neto et al. 2018 Front Genetics 9:57

Polled (BTA1)

Recombinetics at UC Davis

Carcase yield (muscle) - MST

Creating sex-bias

Knock-in SRY

Surrogate males

- Knockout Nanos2 (stop development of germ cells)
- “Recolonise” testis with spermatogonial stem cell

Ciccarelli et al. 2020 Proc Natl Acad Sci U S A. 29;117(39):24195-24204
Thank you

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