Real Approaches to Genetic Improvement Project

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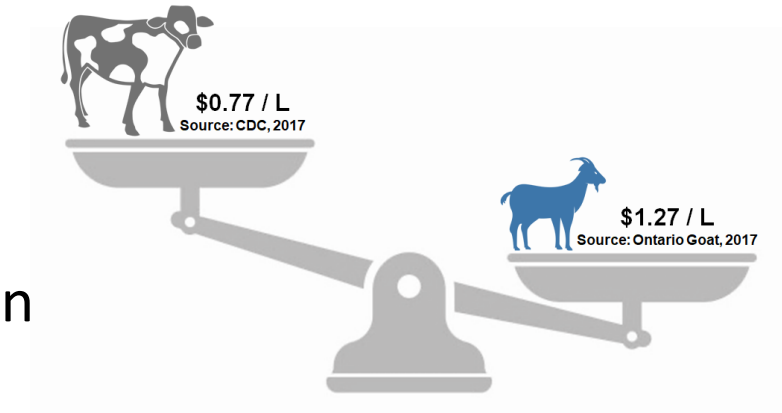
What have we learned?

Key Points of the Webinars

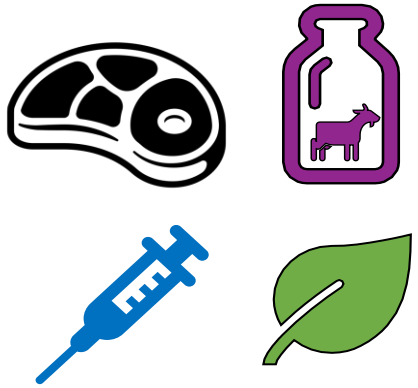
The Importance of Genetic Improvement

- Genetic improvement is a long-term goal and solution.

- Some advantages of focusing on genetic improvement is it can impact:
  - Industry and farm-level profitability and competitiveness
  - Environmental impact
  - Public perception
  - Adaptability for future market demands



Profitability and Competitiveness



Adapting for Future Market Demands

(17) (PDF) How to teach Animal Breeding and Genetics to undergraduate students: presentation of a thinking process (researchgate.net)

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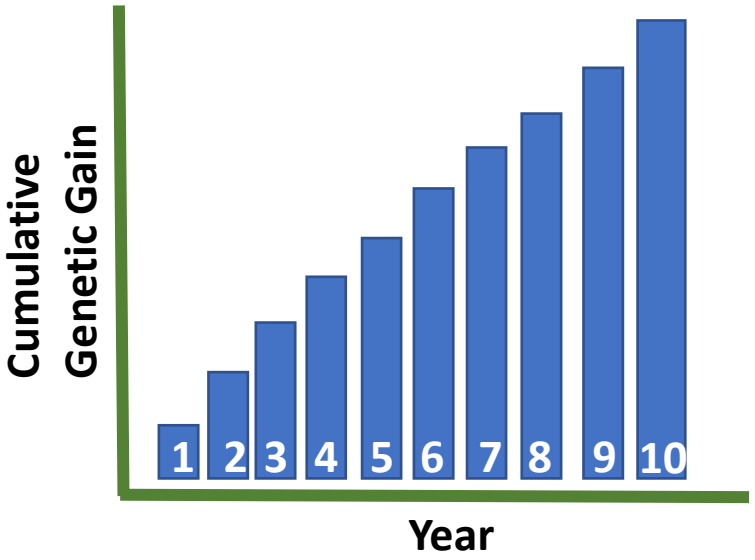
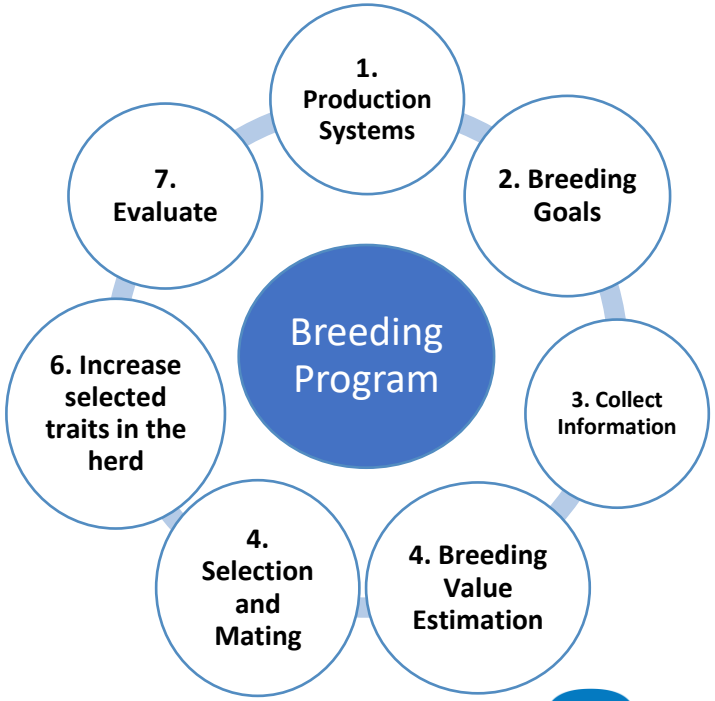
Keep or Cull:

Strategies for Replacement and Culling Decisions

Erin Massender and Marlene Paibomesai (OMAFRA)



- Selection and culling decisions are made to change the average performance in the population over time.
- Factors that impact rate of genetic progress include: selection intensity, accuracy, genetic variation, genetic interval, and number of traits.
- Maintaining genetic diversity and limiting inbreeding can be achieved by purchasing new buck and doe genetics.
- Voluntary and involuntary culling influence the number of replacements to keep or purchase each year
- Specific Measurable Attainable Relevant Timely breeding goals help guide your selection decisions



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Scrapie and Goat Genetics in Canada

Dr. Amanda Amaratunga, DVM – Canadian Food Inspection Agency

- For Canada to reach our goal of eradicating scrapie, surveillance must target geographically underrepresented areas of Canada and testing of significantly more mature (>12 month) goats.
- Based on current science, CFIA recommends focusing on alleles S146 and K222 when breeding for scrapie resistance in goats.
- CFIA will be conducting a pilot project in scrapie positive goat herds to better understand the utility of using genetics as an effective tool to help control scrapie.
- Goat producers can do their part by identifying goats, submitting mature dead or slaughtered goats for scrapie testing, reducing inbreeding, selecting for scrapie resistance, and buying goats from (or enrolling on) the Scrapie Flock Certification Program (SFCP).

Scrapie genotyping is used to prevent sheep from destruction when a scrapie outbreak is detected, new projects in goats aim to use genotyping as a tool for outbreak control too.

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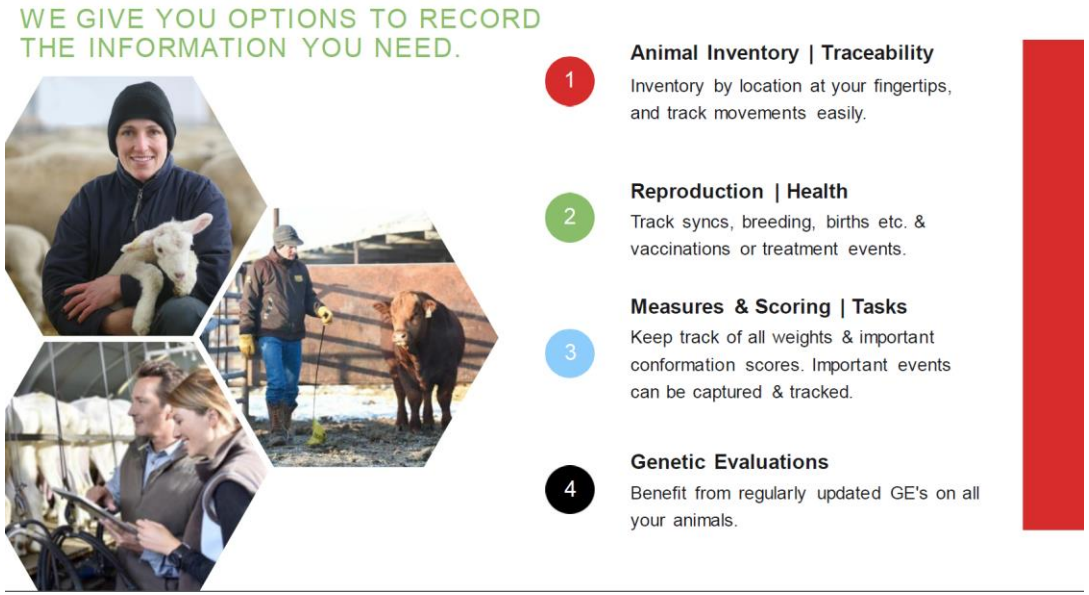
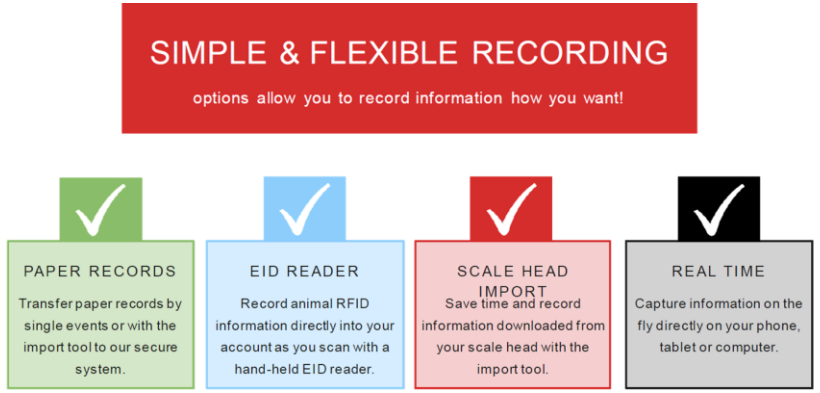
Raising Goats $marter Not Harder

Adam Black, AgSights

- You cannot manage what you do not measure!
- Know your market and the information needed to make buying decisions.
- Choose a record keeping solution that fits into your daily routine that you are comfortable with i.e., don't choose software if you don't like using a phone or computer.
- It has to be easy, or you won't stick with it.





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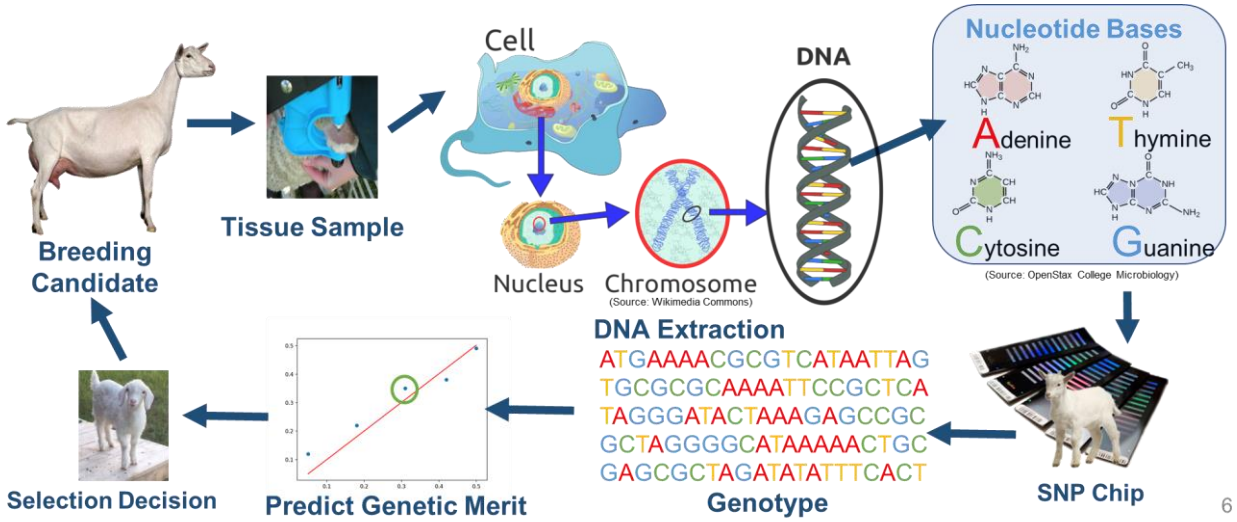
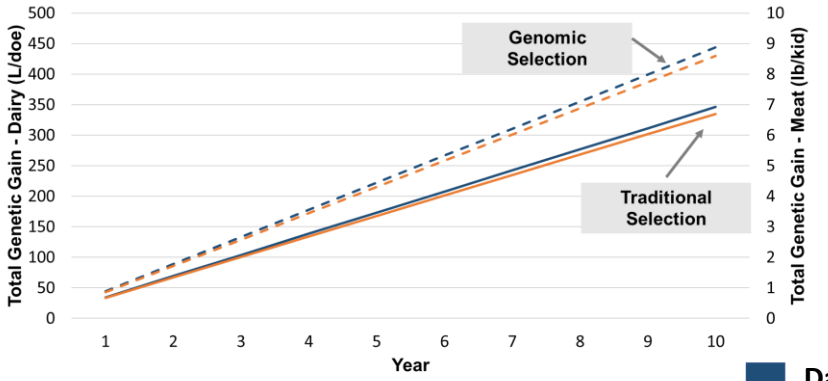
Accelerating Goat Genetic Improvement with Genomic Selection

Erin Massender, University of Guelph and OMAFRA

- Genomic selection uses small differences in the DNA of individual animals in order to more accurately predict genetic merit of young breeding candidates.
- Proven to rapidly accelerate genetic gain and enable selection on difficult to measure traits. Genotyping costs have decreased significantly in recent years making it a feasible selection tool.
- Substantial gains in accuracy are expected from its implementation for the Canadian Alpine and Saanen breeds, especially for does without records and bucks without daughter records.





Remember: Genetic gain is cumulative!
Small differences in yearly genetic gain lead to big changes overtime!

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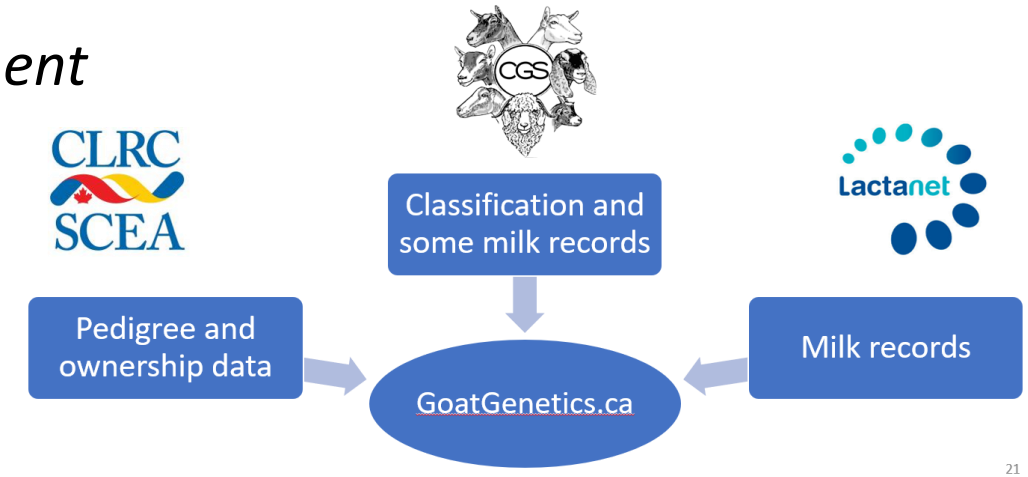
Canadian Dairy Goat Genetic Improvement Program

Brian Sullivan, Canadian Centre for Swine Improvement

- Genetic improvement can reduce costs and increase revenue.
- National genetic evaluations for dairy goats are available at www.GoatGenetics.ca.
- Information on data recording programs is available from the Canadian Goat Society: www.goats.ca.



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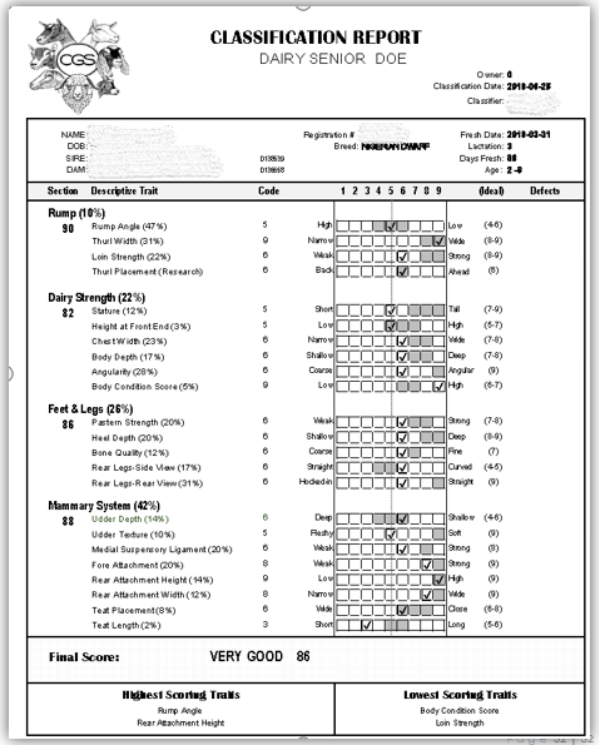
Introduction to CGS Classification

Callum McLeod, Canadian Goat Society

- The purpose of classification is to assess an individual animal's structure according to the ideals of a dairy animal.
- The traits being assessed translate into identifying productive and sturdy animals.
- Classification can be used as both selection and culling tools to increase productivity and longevity in the herd.



CLASSIFICATION REPORT
DAIRY SENIOR DOE

Owner: 0
Classification Date: 2019-04-25
Classifier:

NAME:
DOB:
SIRE: D138639
DAM: D138658

Registration #
Breed: NUBIAN DWARF

Fresh Date: 2019-03-31
Lactation: 3
Days Fresh: 88
Age: 2 -8

Section	Descriptive Trait	Code		1 2 3 4 5 6 7 8 9		(Ideal)	Defects
Rump (10%)							
90	Rump Angle (47%)	5	High	✓	Low	(4-6)	
	Thurl Width (31%)	9	Narrow	✓	Wide	(8-9)	
	Loin Strength (22%)	6	Weak	✓	Strong	(8-9)	
	Thurl Placement (Research)	6	Back	✓	Ahead	(5)	
Dairy Strength (22%)							
82	Stature (12%)	5	Short	✓	Tall	(7-9)	
	Height at Front End (3%)	5	Low	✓	High	(5-7)	
	Chest Width (23%)	6	Narrow	✓	Wide	(7-8)	
	Body Depth (17%)	6	Shallow	✓	Deep	(7-8)	
	Angularity (28%)	6	Coarse	✓	Angular	(9)	
	Body Condition Score (5%)	9	Low	✓	High	(6-7)	
Feet & Legs (26%)							
86	Pastern Strength (20%)	6	Weak	✓	Strong	(7-8)	
	Heel Depth (20%)	6	Shallow	✓	Deep	(8-9)	
	Bone Quality (12%)	6	Coarse	✓	Fine	(7)	
	Rear Legs-Side View (17%)	6	Straight	✓	Curved	(4-5)	
	Rear Legs-Rear View (31%)	6	Hocked-in	✓	Straight	(9)	
Mammary System (42%)							
88	Udder Depth (14%)	6	Deep	✓	Shallow	(4-6)	
	Udder Texture (10%)	5	Fleshy	✓	Soft	(9)	
	Medial Suspensory Ligament (20%)	6	Weak	✓	Strong	(9)	
	Fore Attachment (20%)	8	Weak	✓	Strong	(9)	
	Rear Attachment Height (14%)	9	Low	✓	High	(9)	
	Rear Attachment Width (12%)	8	Narrow	✓	Wide	(9)	
	Teat Placement (8%)	6	Wide	✓	Close	(8-9)	
	Teat Length (2%)	3	Short	✓	Long	(5-6)	

Final Score: VERY GOOD 86

Highest Scoring Traits	Lowest Scoring Traits
Rump Angle	Body Condition Score
Rear Attachment Height	Loin Strength

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Real Approaches to Genetic Selection:

Poll Questions and Discussion Activities

Discussion Questions – Participation is key!

- This part of the webinar will have:
  - Polls on genetic improvement in your herd or client's herds
  - Discussion activities in breakout rooms

Poll Questions

Breakout Room Activity Instructions

- 3 Discussion Activities
  - 10 minutes for discussion of each activity in breakout room
  - 5 minutes for report back after the breakout room

- Each group will have a helper sharing their screen to show the activity description and take notes
- Assign one reporter for discussion in the larger group
- Breakout rooms are pre-assigned and you will be automatically put there
- You can participate in breakout room activities either by phone or webinar
- ***Message Marlene or Erin if you have a question or need help***

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Activity #1: Record Keeping Discussion

Open discussion on record keeping and what is preventing keeping records on farm

1. Introduce Yourself!
   - Name
   - Dairy or Meat Focus
   - Location / Organization
2. With unlimited resources – what are the top three things you would record on your farm or clientele farms and why?
3. What is the number one barrier that prevents you or your clientele from keeping records? What would reduce this barrier?

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Breakout Room Activity #1

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Activity #1 - Wrap Up Comments:

- You can’t manage what you don’t measure!
- Herd breeding goals and experience will inform what records are most important to keep on an individual farm
- Individual identification is the first step towards being able to keep effective records for genetic improvement
- Collecting data is not useful if you don’t have a plan for how you will analyze it and what decisions you will make with it
- Challenges to record keeping include: time, cost, labour availability, technology limitations etc.

Activity #2: How many to keep?

Objective: Using the equations provided, practice calculating herd turnover rate. Consider the impact of herd breeding goals and kid mortality on herd turnover rate and the number of replacements retained.

Take-aways include:

- Learn how to calculate herd turnover
- Impact of herd goals (e.g., reducing prevalence of CAE, reducing kid mortality) on herd turnover and the number of replacements retained.

How many replacements do you keep?

Herd turnover rate is dependant on the number of does voluntarily and involuntarily leaving the herd and average herd inventory

Records that you need to keep:

- ✓ Animal inventory
- ✓ # of does that die on farm including euthanized animals
- ✓ # of does that exit the herd for economic reasons

How do you determine the number of replacements:

- Calculate herd turnover for a specific period or group of animals
- Desired herd size (expanding, stable or decreasing)

Other considerations:

- ✓ Ability to produce and sell product
- ✓ Barn space
- ✓ Amount of feed
- ✓ Moderate vs. intense culling
- ✓ Kid mortality

(Fetrow et. al., 2006)

Culling from the Herd

- **Involuntary Culling** – The removal of breeding stock or potential replacements from the herd due to no productive future (e.g., illness, injury, infertility, CAE positive or death)

- **Voluntary Culling** – The removal of breeding stock or potential replacements because they do not meet an economic and breeding objective criteria (e.g., poor production, temperament).

$$\text{Herd Turnover Rate} = \frac{\text{Number of does culled over a specified time}}{\text{Mean doe inventory for the specified time}}$$

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Calculating Herd Turnover Rate

Specified Time : 1 year

Adult Mortality: 5%

Herd Turnover Rate = $\frac{\text{Number of does culled over a specified time}}{\text{Mean doe inventory for the specified time}}$

Herd Turnover Rate = $\frac{\text{34 does over 1 year}}{\text{100 does over 1 year}}$

Herd Turnover Rate = 34%

Doe Inventory & # of Culls 1-year

Month	Inventory	Culls
1	100	3
2	105	2
3	110	4
4	95	3
5	93	3
6	95	2
7	100	4
8	97	3
9	96	3
10	101	2
11	105	1
12	100	4
All Months	**100**	**34**

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Breakout Room Activity #2

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Activity #2 - Wrap Up Comments:

- It can be hard to determine what is “good” or an industry standard when comparing herd turnover rates
- It is useful to keep records on *why* animals were culled from the herd
- Knowing adult mortality rates can give you an idea of what proportion of the culls are voluntary (e.g., poor performance) or involuntary (e.g., death or disease)
- Factors Increasing Herd Turnover:
  - Intensive culling strategies
  - High adult mortality, or involuntary culling (i.e., CAE)
  - Keeping more replacements with a stable herd size
  - Decreased product demand
- High kid mortality will decrease herd turnover rate and increase the proportion of replacements that need to be retained to maintain a steady herd size
- Higher voluntary culling and greater herd turnover will increase the rate of genetic progress, but increase rearing costs

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Activity #3 - Breeding Scrapie Resistance Into Your Herd

Objective: The CFIA aims to eradicate Scrapie from Canadian small ruminant farms to open new market opportunities internationally. Genetic testing and selecting for Scrapie resistance is one tool that could help to control the spread of the disease and the efforts towards eradication. This activity will allow you to consider some of the factors to consider in a strategy to breed Scrapie resistance into your herd.

- **Take-aways include:**
- Understand what alleles are associated with susceptibility and resistance to Scrapie and the prevalence of favourable alleles in various breeds.
- Strategies to consider when developing a breeding strategy for Scrapie resistance in the herd.

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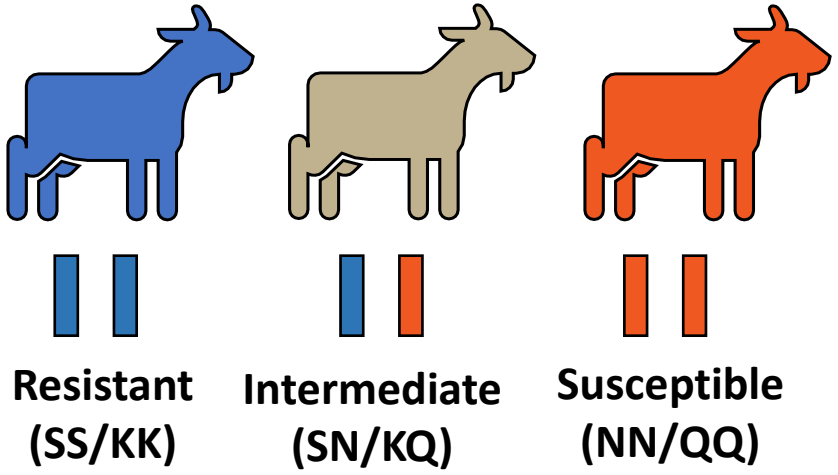
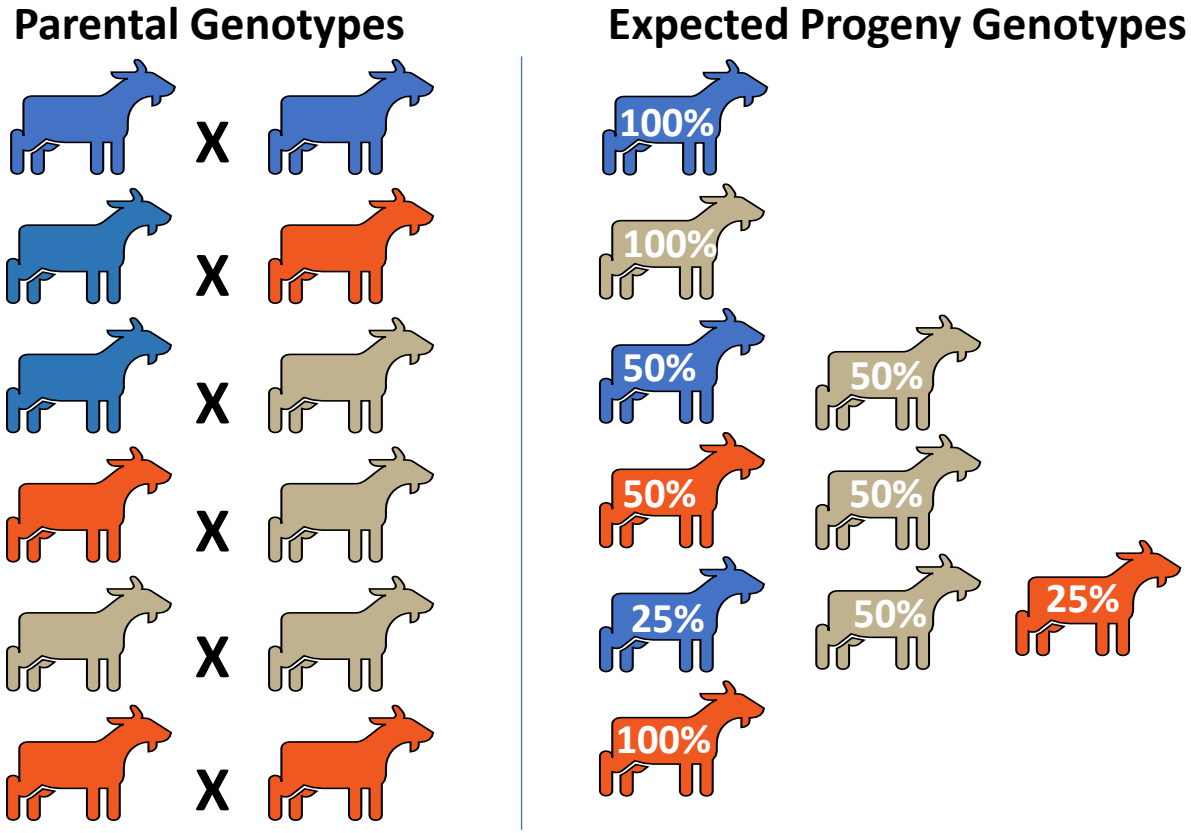
Scrapie Genetics Overview

- Susceptibility or resistance to Scrapie is controlled by variations (alleles) in the *PrP* gene
- Genetic resistance to scrapie has been studied for several different protective alleles including K222 and S146
- The prevalence of the resistance alleles vary by breed and country





Breed	Frequency of Protective Allele
Alpine	6.4-7.5%
Saanen	1.2-4.0%
Toggenburg	1.9-29.5%
Boer	24.5-31.0%

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Breakout Room Activity #3

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Activity #3 - Wrap Up Comments:

- Breeding scrapie resistance into the national herd will be an incremental process,
- The frequency of the protective alleles (S146 and K222) vary between breeds
- If available, the fastest way to introduce Scrapie resistance into your herd is to purchase a buck that is homozygous for the protective alleles (SS or KK).
- Given the low frequency of protective alleles in some breeds, availability of resistant breeding stock may be limited.
- It will be important to manage matings carefully to manage genetic diversity (e.g., minimize inbreeding and relationships between families) in the herd
- High herd turnover rates (short generation intervals) will aid in a breeding strategy for Scrapie resistance
- Scrapie resistance will have to be balanced with other herd goals (e.g., increasing production or reproductive performance)
- Uptake of routine genotyping as part of the genomic evaluation system may help us to identify the true prevalence of resistant alleles.

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Thank you for attending the goat genetic improvement webinar series!

Please complete the post-event survey and help us pick what topic to cover next!

Slides and presentation recordings will be sent via email next week.

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Questions?

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