Genetic improvement in Sheep and Goat Project

Breeding Strategies

Virtual training 2021

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Rule of Thumb

- In a commercial lamb operation the number and quality of market lambs are important, so both terminal and maternal characteristics need to be incorporated into the breeding strategy.
- The purebred producers sells his “Seed Stock” to cross breeders

Benefits of Crossbreeding

1. Hybrid Vigour or Heterosis

- **Hybrid vigour** refers to the fact that crossbred offspring (F1) often outperform the average of their parents. Hybrid vigour decreases as the heritability of a trait increases. Therefore, it is often used to improve performance for low heritability traits.

Explanation of above slide

- Hybrid vigor means strength and heritability is referring to the traits obtained from each parent. So, basically this is saying that a crossbred animal is better because the purity of a trait decreases. A purebred animal won't perform as well as a crossbred animal when there is a specific desirable trait. For eg. If you want an animal for its heavy carcass(Meat) then a cross between two meat type sheep would do this for you (Dorper X Katahdin).

HETEROSIS: The tendency of a crossbred lamb to show qualities superior to those of both parents

Table 1. Potential heterosis effects in sheep

Crossbred Lamb (Individual)		Crossbred Ewe (Maternal)	
Trait	**Heterosis (%)**	**Trait**	**Heterosis (%)**
Birth weight	3.2	Fertility	8.7
Weaning weight	5.0	Prolificacy	3.2
Preweaning ADG	5.3	Body weight	5.0
Postweaning ADG	6.6	Fleece weight	5.0
Yearling weight	5.2	Lamb birth weight	5.1
Survival to weaning	9.8	Lamb weaning weight	6.3
Carcass traits	≈ 0	Lamb survival to weaning	2.7
		Lambs born/ewe exposed	11.5
		Lambs reared/ewe exposed	14.7
		Weight of lamb weaned/ewe exposed	18.0

Source: Sheep Production Handbook, American Sheep Industry Assoc., Inc., 2002 ed., vol 7.

Benefits of Crossbreeding

2. **Complementary**

- This refers to the crossing of two similar breeds in order to combine the best traits of both breeds.
- For e.g – This is like crossing a Dorper and a Katahdin to maintain weight gain and carcass quality.

Crossbreeding Systems

Performance of three breeds of sheep

Breed	Fertility, %	Prolificacy, no.	Lamb survival, %	Lamb wean. wt., lb.	Wt. wean. per ewe, lb.
Finnsheep	90	2.30	90	40	74
Dorset	90	1.60	85	48	59
Hampshire	90	1.45	80	55	57
Average	90	1.78	85	48	63

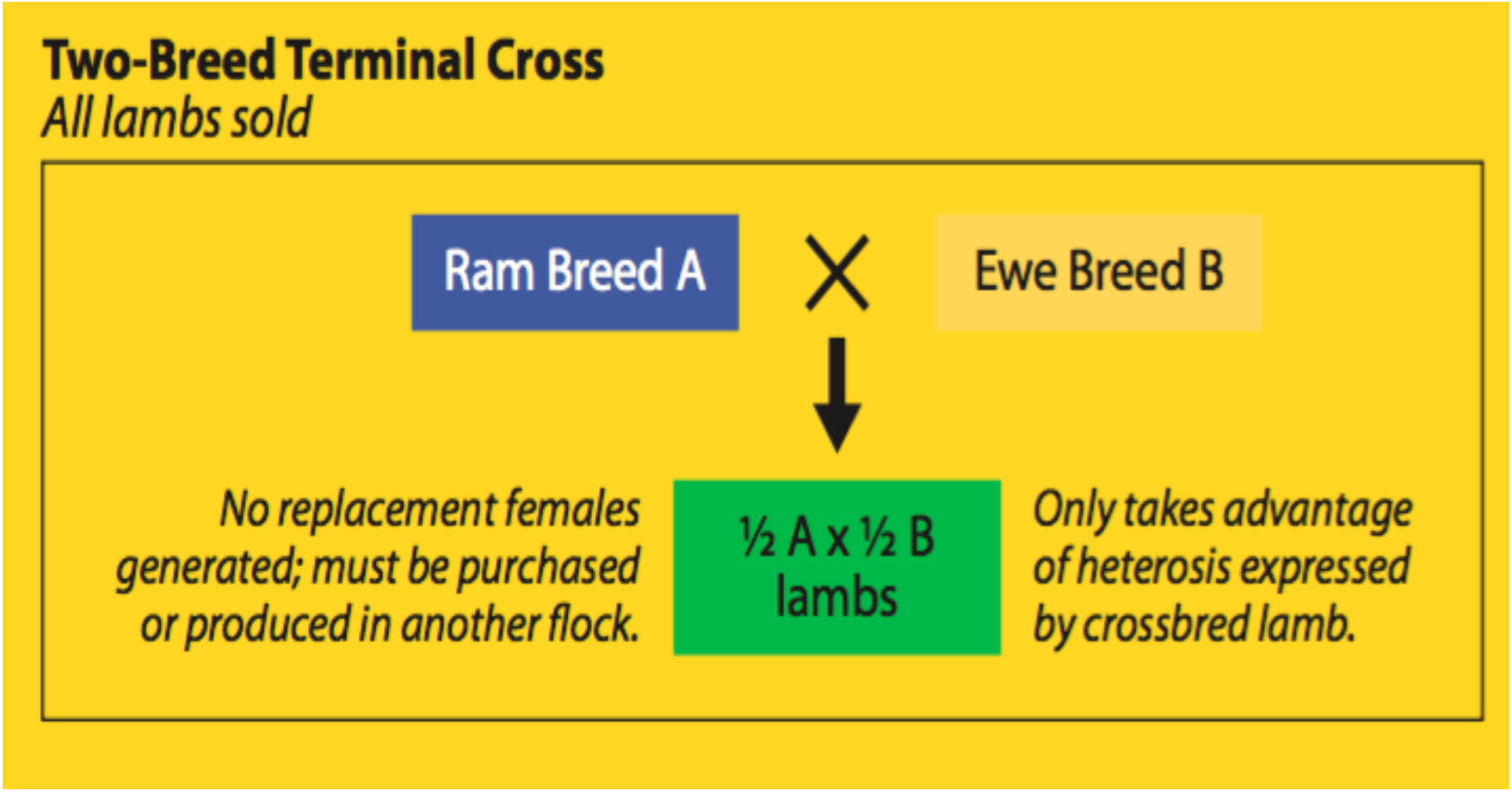
Types of Crossbreeding strategy

- 1. Two way Cross – Black Belly x Pelibuey
- 2.Criss-Cross(Two Breed Rotational cross) BB (male) x PB (female) then PB (male) x BB (female)
- 3. Three way Cross – BB x PB = 50% mix then crossed with Katahdin
- 4. Three-way Rotational – BBxPbXDP = F1XDP
- 5. Three-breed Roto-Terminal Crossing

Two Way Cross

- In this case, rams of one breed are used to breed ewes of a second breed, resulting in crossbred lambs. This strategy takes advantage of hybrid vigour and/or complimentary breeding in the offspring. Breeding is relatively simple as you are only dealing with one breed of ewes and one breed of ram.

Two way Cross(Two-breed Terminal Cross)



Criss-Cross (Two breed rotational Cross)

- The two-breed rotational cross or criss-cross is a relatively simple and popular form of crossbreeding. In this system, two breeds are mated and the resulting female (F1) offspring are kept as replacements and mated back to one of the breeds. In following generations (F2), females are bred to the opposite breed of their sire.

Criss-Cross(Two breed rotational Cross)

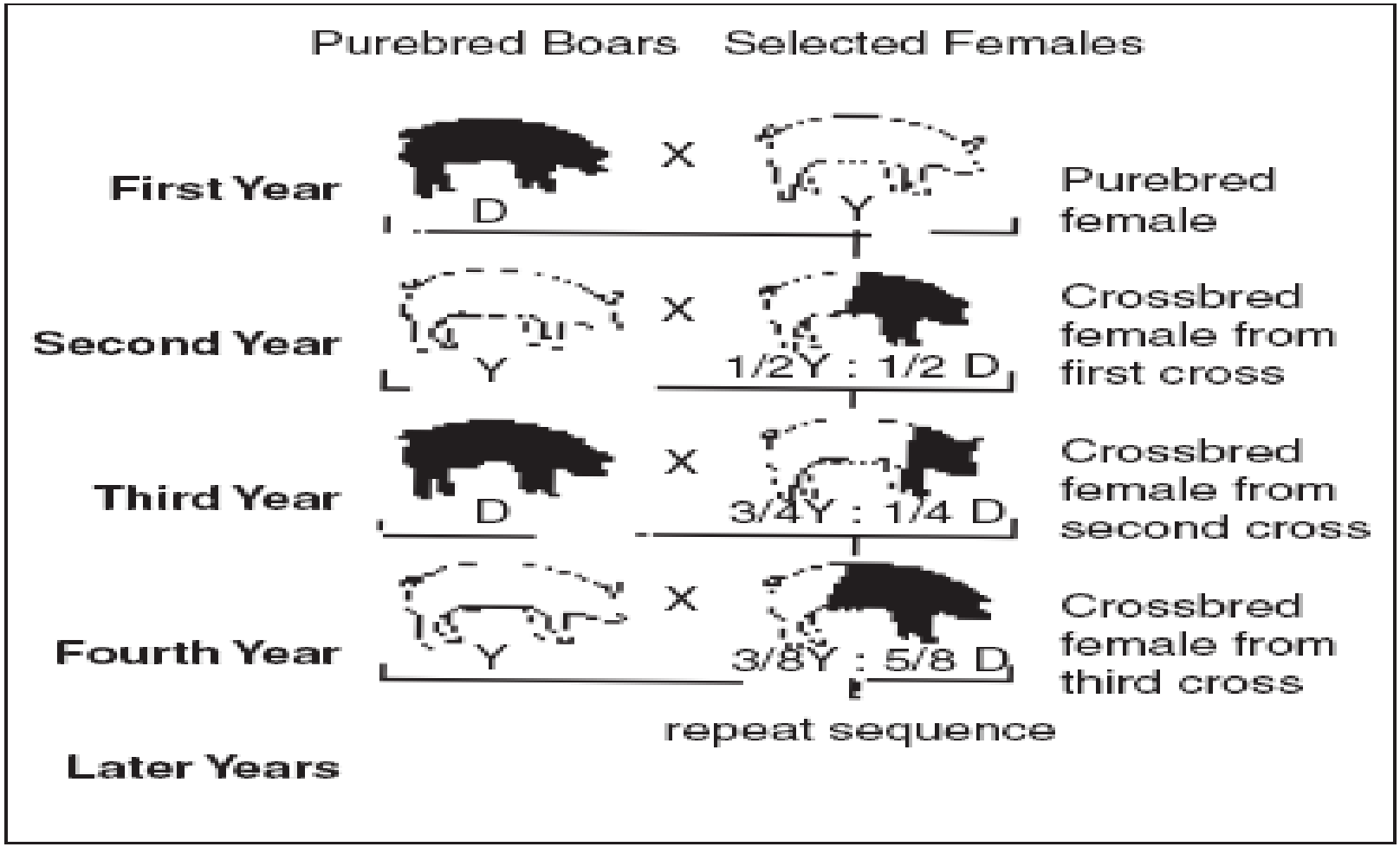


Figure 2. Two-breed rotation cross system.

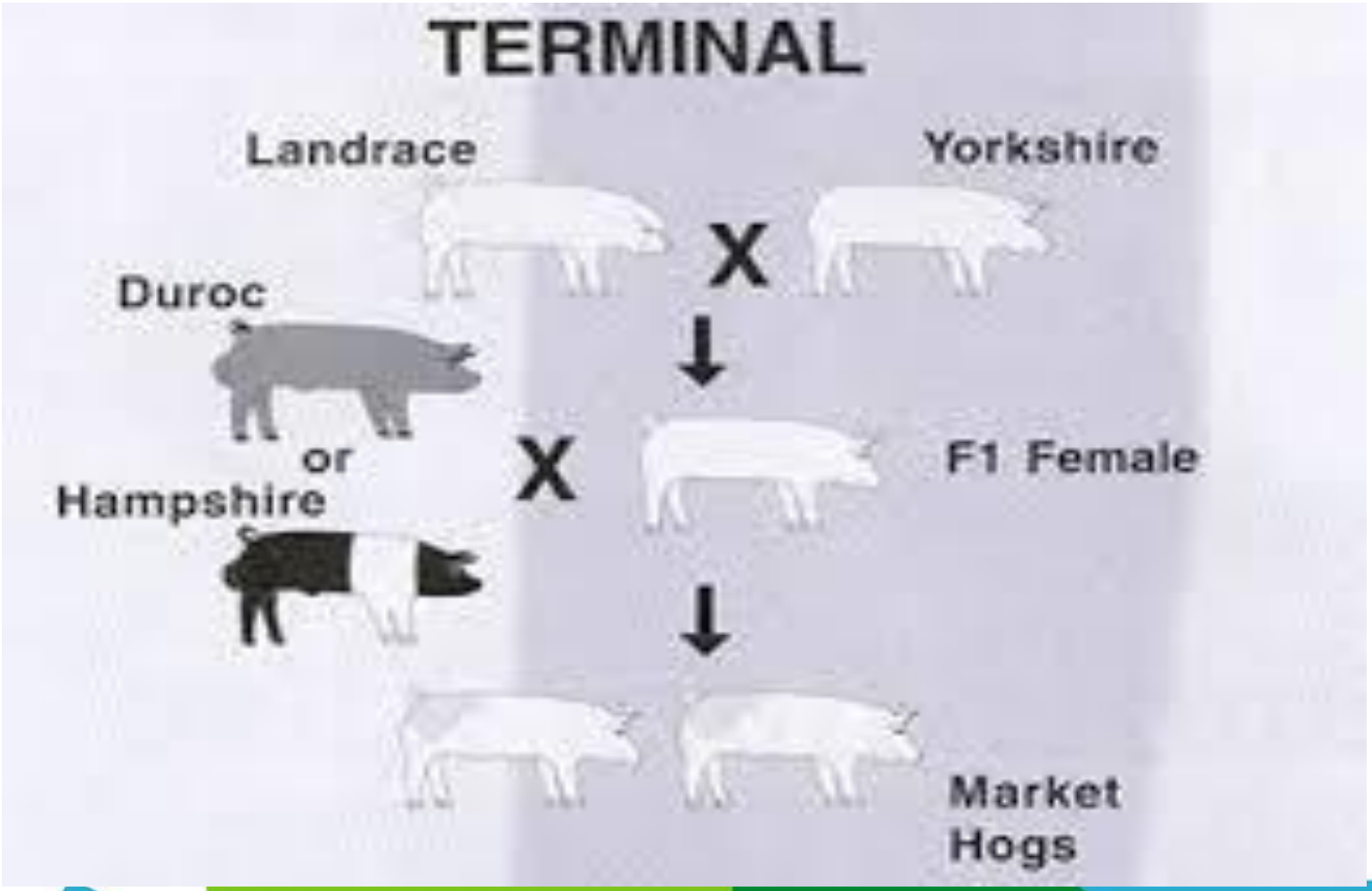
Criss-Cross(Two breed rotational Cross)

- E.g.
- A Dorper ewe is bred by a Katahdin ram and produce an offspring (F1-female).
- That F1-female is then mated with a Dorper ram
- That is known as Criss-Cross Rotational Breeding

Criss-Cross(Two breed rotational Cross)

- This strategy mates the two-way crossbred ewe lambs (‘F1’ lambs) to a ram of a third breed. The resulting progeny are a mix of three different breeds. This strategy takes advantage of hybrid vigour in the crossbred ewe as well as in the three-way crossed lambs. However, all replacement ewes still need to be purchased. Some producers specialize in producing crossbred ewe lambs for this type of system.

Three way Cross(Three-breed terminal Cross)



Three way Cross(Three-breed terminal Cross)

- In a terminal breeding system, a crossbred ewe (F1) is mated to a terminal purebred ram and all animals are sent to market. Replacement ewes are not kept for mating and therefore must either be purchased or produced separately. Purebreds can be used in a specialized role (i.e. to produce only females or only market sheep) and therefore the strong characteristics of each breed can be fully realized

Three way Cross(Three-breed terminal Cross)

- **Advantages**
- Maintain 100% heterosis in both the ewes and market animals.
- Can take full advantage of each purebred breeds strengths.
- Uniform market animal as every animal produced is the same genetically.
- System is easy to manage if replacement ewes are purchased and all animals produced go to market
- **Disadvantages**
- If F1 female is purchased, this is an additional cost and disease could possibly be introduced into your flock.
- If F1 female is produced by you, it requires more management as two genetic pools must be maintained, one to produce replacement females and one to produce market animals.

Three-Way Rotational

- Crosses Similar to the three-way cross, the three way rotational cross starts with mating a crossbred ewe to a ram of a third breed. The crossbred ewe lambs are kept as replacements rather than being sold. These three-way cross ewe lambs are then mated to one of the two breeds in the first cross, and the process continues in the same manner.

Mating to the Three-Way Rotational Cross

Generation	Ram	Ewe
1	Dorper	Black Belly x Pelibuey
2	Black Belly	½ Dorper x ¼ Black Belly x ¼ Pelibuey
3	Pelibuey	5/8 Black Belly x 2/8 Dorper x 1/8 Pelibuey
4	Dorper	5/8 Pelibuey x ¼ Black Belly x 1/8 Dorper
5	Black Belly	5/8 Dorper x ¼ Pelibuey x 1/8 Black Belly

Three-way rotational

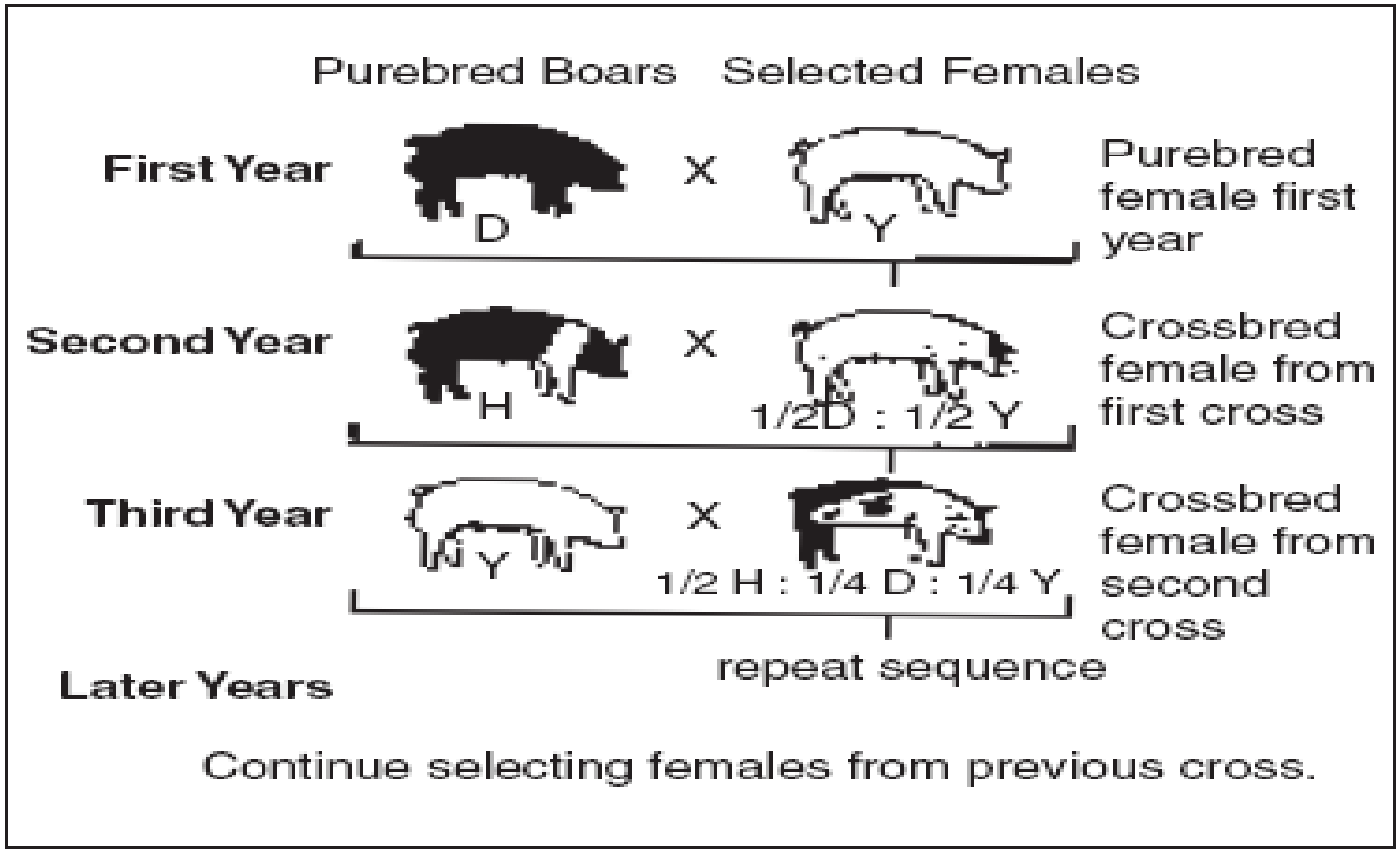
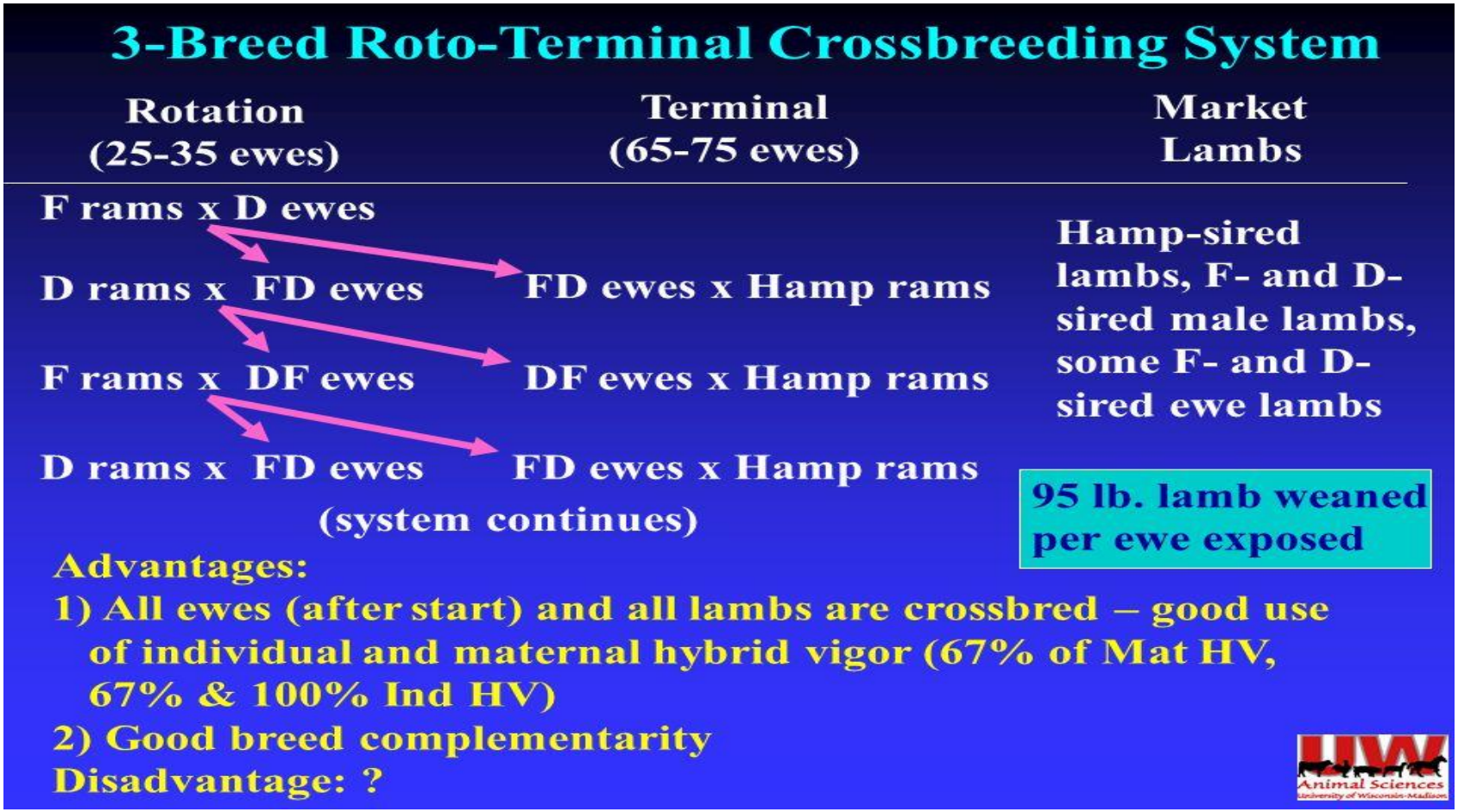


Figure 2. Three-breed rotation cross system.

Three-breed Roto-terminal crossing

- This type of breeding program combines three-way crossing and the rotational crossing programs. This strategy produces replacements within the system and retains hybrid vigour in the ewe flock. However, three separate breeding groups are required each year to accommodate the three different breeds of ram, which requires reliable animal ID and record keeping systems.

Three-breed Roto-terminal System



Three-breed Roto-terminal System

- Rotaterminal combines the rotational and terminal breeding systems. In a rotaterminal, top females are slected and used in a rotational cross that produces replacement gilts. Maternal breed purebred boards are used in this rotation. The replacement gilts are then mated to terminal boars for market production.

Three-breed Roto-terminal System

- **Advantages**
- Maintain 86% heterosis in ewes and 100% heterosis in market sheep.
- Produce your own replacement ewes.
- Replacement ewes are produced from top ewes which means better performance.
- Market animals are uniform as all are sired by same breed of ram.
- **Disadvantages**
- Requires better management and breeding as you have two genetic pools, one producing your replacement ewes and one your market animals.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Thank You