**Reproduction Modification – Sheep**

The purpose of various livestock reproductive technologies and techniques, such as flushing, pregnancy scanning and ram selection, is to help increase the lambing percentage, provide information for better management of livestock, and to improve the genetic potential of the farmers flock. This creates an opportunity for the farmer to make more profit, as they could have more and better finishing lambs to send to the works.

**Flushing**

Flushing is carried out by providing ewes with a rising plane of nutrition. This can be done using good quality feed like fresh pasture, bailage, or grain, for two weeks before tupping as opposed to giving them only maintenance feed. Depending on the amount of feed available, the farmer will continue to flush the ewes for another two to four weeks after tupping. The purpose of this is to increase the ewes energy and nutrient intake, which helps to improve the ewes body condition, as six weeks of grazing on good quality pasture can increase a ewes condition score by one. This is important as thinner ewes respond well to flushing, typically ones that have had lambs in the previous year and lost weight throughout the winter and lambing. It is best for ewes to have an optimum condition score of 3.5 to help carry them through the winter, and increase the birth weight of their lambs in the spring . A ewes condition score is determined by the amount of fat and muscle covering the spinous processes on the loin area of its back.

In autumn the nights get longer, causing more of the hormone melatonin to be produced within the ewes brain, which causes the oestrus cycle to begin. This cycle lasts between 13 and 17 days. During this cycle there are four different phases; proestrus, oestrus, metestrus, and diestrus. The ewe can get in lamb during oestrus, which lasts about 24 hours. Ovulation also occurs during this phase of the cycle. There is a significant connection between the ewes live weight gain and rate of ovulation, as a study showed that there can be up to a 6% increase of a ewe have twins for every 4.5kg of weight gained. This is because flushing boosts the rate of ovulation, meaning more eggs are released from the ovaries, so the ewe is more likely to have twins or triplets because more eggs are fertilized during mating. The fertilized eggs are also more likely to be implanted in the uterus, because there is plenty of feed available and the ewe isn’t under much stress. The fertilized egg is more likely to be shed if the ewe is excessively thin or fat, or under other stress, meaning the ewe would have less lambs or be dry.

As a result of flushing the lambing percentage can be increased by 10 to 20 percent, meaning the farmer has the opportunity to make more profit as they have more lambs to finish and sell. While deciding whether or not flush their ewes, a farmer would need to take into account the season and the amount of feed they have available, as they need to be sure they will have enough feed to carry their stock through the winter. This can be done by creating a feed budget, using programs like Farmax or Hawkeye. The farmer could also consider buying in supplementary feed to flush their ewes or carry them through the winter.

Sequence of steps for flushing ewes:

1. Shortly after weaning go through all the ewes and condition score them, then draft out the thin ewes with a condition score of below 3. This is important because the different groups of ewes need to be fed differently to increase their condition score and get the most out of flushing.

A picture containing graphical user interface

Description automatically generated

1. Feed the thin ewes appropriately to get them back into good condition (condition score of about 3.5), as ewes that are not too thin and not too fat are more likely to produce and be able to look after a healthy lamb in the spring. In the long term this will help to increase profit made, by having more lambs to sell.
2. Measure your pasture and use this information to create a feed budget. A feed budget will help the farmer to make important feed management decisions.
3. Assess your feed budget to decide whether or not there is enough feed to flush the ewes and carry them through the winter, and whether supplementary feed needs to be bought. They need to be sure they will be able to provide their stock with adequate feed right through the winter and into the spring before flushing, or else they may find they graze of all the pasture and have no option but to buy in feed from outside sources. It is important for a pregnant ewe to be fed suitably, particularly in the last four to six weeks of gestation, or else the foetus may not develop properly or to its full potential. A well fed ewe will be more likely to have higher lamb birth weights, better mothering instincts, and less risk of metabolic issues like twin lamb disease. During lambing the ewes also need to be fed well as they are lactating and feeding their lambs.
4. Gradually increase the amount of feed the ewes are getting for two weeks. Put the rams out and continue to feed the ewes well for another two to four weeks. This is the process of flushing the ewes, which will help to increase the rate of ovulation so that more eggs are released and the ewe is more likely to have twins or triplets because more eggs are fertilized during mating. The fertilized eggs are also more likely to be implanted in the uterus. This results in a higher lambing percentage, meaning the farmer will make more profit as they have more lambs to sell.

**Scanning**

Ultrasound pregnancy scanning of ewes is a management practice carried out by trained contractors, to determine how many lambs a ewe bears, and if they may be late or early. Although it is costly (about $0.60 per ewe if scanning for dry’s, singles and twins, plus a set-up fee), there are many benefits of scanning which generally save money in the long term. This is because scanning allows a farmer to make more informed management decisions, so there is a better outcome at lambing. This should eventually lead to the farmer making more profit when they sell their prime lambs. Although scanning helps the farmer to make decisions which can influence the outcome at lambing, it is technically not a reproductive modification technique, as the procedure of scanning itself doesn’t help to improve the fertility, genetics or productivity of the ewe.

Sequence of steps for scanning ewes:

1. Organise a date with a contractor for scanning. This needs to be within 80 to 100 days after tupping, during the ewes mid pregnancy period. Scanning outside this period of time causes less accuracy of results, because if the foetuses are too big or too small it is more difficult for the scanner to identify them.
2. The farmer will empty out the ewes, by leaving them in the yards over night with only water and no feed. This is important because it is more difficult for the scanner to see and identify the foetuses when the rumen is full of feed, which leads to inaccurate results.
3. A ewe is run up the race and into a holding crate. The scanner places the probe on the skin just in front of the udder, as this is where the uterus is. The probe sends beams of high frequency sound waves, which echoes off the ewes body tissues, causing the sound waves to be reflected back to the probe. Technology converts this information into an ultrasound image, so the scanner can see the ewes insides and identify how many lambs the ewe has. The scanner will call out how many lambs the ewe has, or that its dry, so someone can mark the ewe with a coloured spray marker. This is important so that the mob of ewes can drafted up into groups, depending on how many lambs they have.

A picture containing grass, outdoor, set

Description automatically generated

1. The scanner may also identify any ewes that are going to lamb particularly early or late, so the farmer can make better management decisions based of how many of these ewes there are. They will also be able to work out what the lambing percentage will be, which will be important for making management decisions.
2. The farmer might in put the information and results from scanning into a computer program like AgriWebb, which makes it easy for them to compare results with previous years, so they can tell if the lambing percentage and productivity if their flock is improving or not.
3. The mob of ewes is then drafted up, so the farmer will have mobs of ewes bearing different numbers of lambs; dry, singles, and twins and triplets. The dry ewes can be culled, and generally for a better price at this time of year. This also means feed isn’t being wasted on an unproductive sheep over the winter. If there are a lot of dry ewes there could be an issue with poor feed management prior and during tupping, or the genetic productivity and/or performance of the ram. Without scanning the farmer wouldn’t know how many dry ewes they had, and wouldn’t necessarily notice if there was an issue.
4. The farmer would have been measuring their pasture to create a feed budget. This will help the farmer to know the dry matter content of their feed, and at what rate it is likely to grow at. This will give them an indication of how much feed they will have for the winter, based off their stock numbers and their feed requirements. They will then also know if they need to buy in any supplementary feed. The farmer will be able to best allocate the feed based on how many single and twin ewes they have, as singles don’t need to be feed as well as twins because they only have one lamb. During the last four to six weeks of a ewes pregnancy it requires the most feed, as this is when the majority of foetus growth occurs. During this period a single ewe has an energy intake requirement of about 17.2 MJME/kg DM, whereas a twin or triplet ewe needs between about 21.1 and 23.1 MJME/kg DM. The feed also needs to be good quality, otherwise the ewe might not be able to consume enough feed to meet its nutritional and energy intake requirements, which can lead to metabolic issues like pregnancy toxaemia or milk fever. By feeding the ewes based on how many lambs they are having, the lambing is more likely to be successful, as twins and triplet lambs may have higher birth weights, but singles shouldn’t be overfed as this could cause them to have difficulties when giving birth. The farmer also needs to be sure they will have enough feed in spring when the ewes are lactating, so they can feed and raise their lambs.

**Ram Selection**

Ram selection is crucial, as it creates the opportunity to improve the genetic potential and productivity of a flock of sheep, which will help the farmer make more profit in the long term. Some of the things a farmer needs to take into consideration when looking to purchase rams include, improvements that could be made to their flock, the statistics and data of the ram they are looking at buying, the conformation of the ram, and overall health of the ram. The ram should be a prime example of its breed, as there can be huge variation within a breed of sheep as well as when comparing different breeds. These things help to ensure that the farmer is bringing positive and productive traits into their flock in the long term.

Sequence of steps for ram selection:

1. The farmer should assess the weaknesses of their flock of sheep and the market demands. This will allow them to consider what traits of their flock could be improved to increase the value of their products produced, such as higher carcass weights or lower wool microns. They will need to decide what breed they are wanting, as different breeds have different traits. This may also depend on whether the ram is a terminal sire, or if it’s for breeding replacement ewes, as this will influence the qualities the farmer is looking for.
2. Rams need to be bought 6 to 8 weeks before tupping, if not sooner. This is to allow time to quarantine the rams when they arrive, give the rams time to settle into a new environment, and to make sure they are well feed and in good condition, so that the rams are more productive at tupping. The farmer needs to contact a stud farm and arrange to visit, or go to a ram sale where they are auctioned.
3. When finding a ram to buy, the farmer should look at its conformation, so that no unwanted traits are bred into the flock. Good conformation is important because of various traits and features that are desirable for meat breeds. It allows the sheep to move and function properly, so it can graze well, gain condition, birth and raise lambs, and therefore be productive and profitable. The farmer should check for any obvious abnormalities of the rams reproductive organs, as an issue would instantly indicate not to buy that ram since it won’t be productive. The larger a rams testicles are the more fertile it will be. When looking at the rams body structure the farmer should look for features which could lead to lameness, like sloping pasterns, splayed feet, or corkscrew toes, as these are traits that don’t want to be bred into the flock. A ram with good conformation for breeding would have features like a square and level rump, wide loins, upright pasterns, smooth shoulders, and a straight back. The ram needs to have a mouth and teeth that are in good condition, because it is important not to compromise the grazing ability of its offspring, as a sheep that can’t eat properly won’t gain condition. Some unwanted traits include an undershot or overshot jaw, and incisor teeth which point forward of the dental pad. The ram should be well grown for its age, and appear alert and present. It is better to have a more aggressive ram, as it will do better at tupping compared to a timid ram. The farmer may also want to consider the rams wool traits, as finer wool is more profitable.

A picture containing grass, outdoor, mammal, sheep

Description automatically generated

1. The farmer should look at the rams performance data, and compare it with other rams. Estimated breeding values are probable measurements of heritable traits, like weaning and after weaning weights, lambing percentage, wool traits, maternal traits, and other genetic information. This helps give the farmer an idea of the productivity of the ram, and how it can genetically improve their flock.
2. The farmer needs to check that the ram they are looking at buying is in good health, so it has no issues which could affect its performance, or diseases that could spread to the rest of the flock. They should check that the ram has no ticks, lice, mites, or other external parasites which could easily spread to other sheep, as this will degrade the value of the wool and make the sheep uncomfortable. The ram should have no discharge from its nose, eyes, or mouth. The farmer should ask about when the ram was vaccinated and drenched, and what with, so they can fit the ram accordingly into their own drenching and vaccinating program. They should also look at the health of the flock that the ram has come from, to reassure they won’t be importing any diseases into their own flock of sheep. They can look at the parasite resistance of the ram, which could be features like less wool around their rear end, so they are less likely to get flystrike. These things are important because parasites and diseases are a cost to the farm, because they can be expensive to treat, and a sheep with health issues won’t be in good condition, and therefore won’t be overly profitable.
3. Once the farmer had bought a ram, it needs to be quarantined in a paddock separate from other sheep for at least three weeks before being put out with the other rams. This is to make sure that if the ram does have an infectious disease it won’t be spread to the rest of the flock.

Genetics:

The processes of meiosis and fertilization influences the genes and traits that the lamb will have, as it will have some from the ewe, and some from the ram. A sheep has 54 chromosomes. Those chromosomes are made up of DNA, which is contains genetic information. The cell division process of meiosis halves the amount of chromosomes, and forms the ovaries in the ewe, and sperm in the ram, which are the gametes. This is because the homologous chromosomes are split in half, so each gamete receives an allele from each pair. An allele is one of two alternative forms of a gene, which results in a specific phenotype or trait. Fertilization takes place at mating, when the rams sperm joins with the ovary within the ewes fallopian tube, and the zygote is formed. The zygote contains 54 chromosomes, half of which are from the ewe, and the other half are from the ram. The ram and ewes genotype for a specific trait is what determines what traits the lamb will have. A punnet square can be used to predict the likelihood of which phenotype the lamb will express, based off the genotype of the ram and ewe. For example; white wool is the dominant allele and black wool is the recessive.

|  |  |  |
| --- | --- | --- |
|  | W | w |
| w | Ww | ww |
| w | Ww | ww |

There is an even chance that the lamb will have either white or black wool, as it could be heterozygous and have white wool but carry the recessive gene for black wool, or it could be homozygous recessive and have black wool. A farmer may use a ram that is purebred, as its genotype for specific traits will be homozygous, which means there is a higher likelihood that the lamb will inherit those traits. It is important for a farmer to have a basic understanding of genetics and the inheritability of genes, so they know why a ram with good genetics can help improve their flock in the long term, and make them more profit.

**Justification**

The two modification techniques that are the most economically beneficial for a farm are flushing and ram selection.

Provided that the farmer has the feed readily available and won’t have to buy in supplementary feed, flushing can help the farmer to make more profit in the long term. Flushing helps to increase the numbers of ewes getting pregnant, and can raise the lambing percentage by 10 to 20%, as there are more twin and triplet bearing ewes. This means more lambs are born in the spring, although this is reliant on the genetics and health of the sheep, feed programs, and environmental conditions. Assuming that the lambs are born and raised, and that the farm has the capacity for a larger number of livestock, this means that the farmer will have more prime lambs to sell that season, and can therefore make more profit. However, if the farmer can’t flush their ewes without buying supplementary feed, or if they won’t have enough feed in the spring, the practice can be a cost to the farm. Also, a ewe may struggle to raise triplets, as ideally a ewe should have two lambs because it has two teats on its udder to feed those lambs. Having an a high number of lambs can also make it more difficult to foster on orphaned lambs.

Ram selection helps to increase a farms profit by improving the quality of lambs sold, and boosting the genetic potential of the lambs. This is because a lamb that has a higher carcass weight, better yield, and grades well is more likely to meet the market demands, and therefore the farmer will get paid more for it. The choice of ram can also influence how many ewes get pregnant, depending on the rams fertility, so there may be more lambs born in spring. This creates an opportunity to make more money. The maternal traits passed on through genetics can impact mortality rates and how many lambs are raised, as a ewe with better mothering instincts is more likely to raise its lambs, so there may be more prime lambs to sell. There can be slight variation between breeds of how long the ewes gestation period is, which could influence when the lambs are ready to be sold. The farmer could plan around this to try and sell them when the price is likely to be higher, like around Christmas or easter. Ram selection can affect wool traits, and therefore the value of the wool. Finer wool with lower microns is more profitable. Buying a ram can be expensive, as a good ram could cost about $1000, but because of the benefits this can be a good investment in the long term.

**References:**

*Breeding and Reproduction,* G. A. Wickham and M. F. McDonald, New Zealand Institute of Agricultural Science

http://www.sheep101.info/201/ewerepro.html

*The Modern Shepherd,* Dave Brown and Sam Meadowcroft

http://www.omafra.gov.on.ca/english/livestock/sheep/facts/02-055.htm#:~:text=The%20practice%20of%20increasing%20nutrient,a%20greater%20response%20than%20yearlings)

https://www.canr.msu.edu/news/flushing-small-ruminants-for-a-higher-ovulation-rate#:~:text=Flushing%20is%20a%20temporary%20but,rates%20by%2010%2D20%20percent.

https://globalanimalpartnership.org/wp-content/uploads/2019/02/Sheep-v1.3-Body-Condition-Score-Assessment-record-template.pdf

https://beeflambnz.com/sites/default/files/factsheets/pdfs/fact-sheet-83-feedsmart-feed-table\_0.pdf

https://extension.psu.edu/nutrition-throughout-pregnancy-for-sheep-flocks

https://beeflambnz.com/sites/default/files/factsheets/pdfs/fact-sheet-72-metabolic-disease-in-ewes.pdf

https://extension.psu.edu/ram-selection-principles