Wool Production in Canada

CANADIAN CO-OPERATIVE WOOL GROWERS LIMITED

MORE SHEEP MORE WOOL

CANADIAN WOOL GROWERS

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Canadian Sheep Federation

Fédération Canadienne du Mouton

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Introduction

The sheep and wool industry in Canada began almost as early as agriculture. The first sheep were brought from France in about 1650 to provide food and clothing. Since that time, sheep have followed settlement to all regions of agricultural Canada and have played an important part in the economy of the country.

Canada is well adapted to sheep and wool production, and through the years this production has been profitable. Wool has played an important role in clothing both civilian and military populations, contributing not only to home industries but also to a substantial commercial textile industry.

Over the years, however, wool production has decreased to only a small fraction of what it used to be. Since 1920, annual raw shorn wool production has not met the requirements of Canadian consumption. Peak production occurred in 1945 when almost 7 million kilograms of shorn wool were produced. Wool production then dropped steadily, but it experienced a revival at the end of the century.

The amount of marketed wool has since declined slightly, directly coinciding with the recent reduction in the Canadian sheep flock, which started to take place around the time of BSE and the closure of the United States border. The border is now opening up, but it did have a negative impact on the industry while it was closed. (Table 1)

Table 1. Shorn wool marketed

Year	1996	1997	1998	1999	2000	2001
'000 kg	1,197.3	1,317.4	1,427.5	1,195.3	1,524.0	1,499.7
Year	2002	2003	2004	2005	2006	2007
'000 kg	1,584.9	1,595.8	1,643.6	1,462.0	1,311.7	1,321.4

Source: Statistics Canada, 2009

Wool growth

Wool is a fibre, or modified hair, that grows from the skin of sheep. Because it is formed as a living substance, its growth is regulated by the inherited characteristics of the sheep and by the general condition of the sheep producing it. Therefore, **the amount and quality of wool produced can be changed through management, breeding and feeding practices.**

The individual wool fibre grows from a small depression, known as a follicle, in the skin. Follicles are well supplied with blood vessels, which carry to the fibre the food materials necessary for its growth. Surrounding each wool follicle are two kinds of glands, known as the sweat and sebaceous (wax) glands, which supply protective materials for the fleece. The sweat glands secrete a material, often called sweat salts, which prevents the fibres from being damaged by sunlight. The sebaceous glands secrete wool grease, which forms a protective covering on the fibre and prevents mechanical damage through rubbing.

Management, breeding and feeding key to wool growth

Wool growth is a continuous process and normally the fibre is not shed. However, some of the Down and Longwool breeds tend to shed in the spring. It has been suggested that wool grows more rapidly immediately after shearing than at any other period of growth, but this is not correct. As long as the animal receives an adequate amount of feed under similar conditions the rate of growth will be uniform. However, a sudden change in feed, exposure to sudden storms, or a high fever, may cause a sheep to lose its fleece (see Fig. 1).

The rate of wool growth is directly related to the amount of feed available. Work at Agriculture Canada's Research Station in Lethbridge, AB has indicated that increasing the protein content of the ration from 1% to 10% increases raw wool production by 16%. Work at the University of California showed that sheep on a submaintenance ration produced 1.1 kg of raw wool annually, whereas those on a fattening ration averaged 3.9 kg. Some of the follicles on sheep fed poor rations failed to function, whereas other follicles produced fine fibres, resulting in lower wool production.

Fig. 1. Normally, wool grows at a fairly uniform rate and is not shed. However, poor nutrition, sickness or sudden changes in feed may cause sheep to slip their fleeces and, consequently, reduce the amount of wool for sale.

Wool production benefits from good flock management

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It is well known that wool traits are highly heritable and genetics plays a large role in the quality of the wool produced. Every grower makes a conscious decision regarding wool quality when they turn in the ram for breeding. Once fertilization takes place, however, the role of genetics is essentially done and environment and management determines how the animal expresses its genetic potential.

Ironically, when producers devote more attention and management to lamb production and increased lamb survival and growth, wool production benefits by the extra attention and producers actually do their wool clip a favour by letting the sheep reach its genetic potential for wool.

Nutrition significantly impacts wool

It is also widely known that nutrition has a large impact on wool production. Wool is the "canary in the coal mine" – for years, researchers have measured, recorded and evaluated wool as a means to assessing animal nutrition and health status. Biologically, the sheep will divert nutrients away from wool production to other requirements in order to survive, reproduce, or provide for their young. This means wool production will be compromised if animals are not fed and managed properly at the various stages of production during the year. Improper feeding shows up first in wool, but it also has detrimental affects on lamb performance during the early part of the lamb's life.

The 2006 National Research Council Nutrient Requirements for Sheep provides detailed information on the nutrient requirements for sheep production, including wool. Nutrient requirements for wool-bearing sheep are not appreciably higher than those of wool-less or hair sheep. Therefore, the small amounts of additional nutrients required for wool production are included in the maintenance requirement. The additional nutritional requirements for the various stages of production are related to the increased requirements for the non-wool components.

The basics of wool production have been known for years and can be found in the wool chapter of the *Sheep Production Handbook* available from the ASI. The follicles that produce the wool fibres are broadly categorized into primary follicles and secondary follicles.

Primary and secondary follicle development

Primary follicles are usually the largest, and generally arranged in rows in the skin in groups of three, known as a trio group. In the fetus, primary follicles are formed first (by 100 days gestation) and all are growing fibre by the time the lamb is born.

The secondary follicles are the most numerous, tend to be smaller and grow finer wool than the primaries. They are formed later on in gestation (day 90 to birth). By birth nearly all the secondary follicles are developed, but many do not mature (produce fibre) until after birth. Most follicles produce a fibre by about one month after birth.

When pregnant ewes are not properly fed and managed during late gestation and lactation, wool growth for the ewe is impaired and reduced. However, this improper feeding can also reduce secondary follicle development in the growing fetus(es) and nursing lamb(s). If the follicles do not mature and develop, they cannot grow wool fibres and this will be detrimental for wool production the entire life time of the young animal. Therefore, managing and feeding ewes for fetal growth and lactation is critically important for producers from both the lamb and wool side of the equation.

Avoid overfeeding to maximize returns

On the other hand, overfeeding is not only uneconomical and costly for the flock, it can also be a negative for wool. Overfed ewes are more prone to ketosis or pregnancy toxemia, birthing problems, lambs that lack vigour and reduced milk production. The end result is lambs that are not as thrifty early on in life during the crucial period of secondary follicle development and maturation. In addition, overfed ewes will have coarser wool, which is lower in value. Overfeeding is economically and biologically damaging.

The bottom line is growers who focus on lamb production by feeding their sheep properly throughout the year are helping their sheep grow the best wool genetically possible.

Characteristics of wool

The use of wool as a textile fibre dates back to 4000 B.C. when it was used as such by the Babylonians. Its unique physical and chemical characteristics have been responsible for its great versatility and high value in the manufacture of clothing. Although many scientists have tried, they have not been able to produce a synthetic fibre with the same specific characteristics as wool.

Fineness of wool

The fineness, or thickness, of the fibre is the most important single characteristic of wool, greatly influencing its economic value. The degree of thickness determines whether the finished fabric will be a fine dress material or a coarse floor covering. In the wool trade, fineness is either judged visually or measured precisely – it is on this basis that the grades of wool are determined. Wool grades according to their origin (English, American, and Canadian) are given in Table 2.

Micron system provides accurate measurement

Increased emphasis on an exact and highly descriptive method of describing wool grade has produced a measuring system in which individual fibres are accurately measured. The unit of measure is the micron, which is one millionth of a metre or 1/25,000 of an inch. Fineness is expressed as the mean fibre diameter.

From a casual observation it would appear the fibres growing on a sheep's skin are relatively uniform in thickness. However, the fibre thickness may vary from 10-70 microns within the same fleece (see Fig. 2). Rambouillet fleeces usually average 20-25 microns in fibre thickness, whereas Lincoln fleeces average 35-40 microns.

Table 2. Wool grades and their characteristics

English (spinning count)	American	Canadian	Average length (cm)	Thickness range (micron)
64s, 70s, up	Fine staple	Range fine	5.0 - 7.5	19.6 - 22.5
64s, 70s, up	Fine clothing		Under 5.0	
58 - 60s	One-half staple	Range half	6.5 - 9.0	22.6 - 25.5
58 - 60s	One-half clothing		Under 6.5	
56s	Three-eighths staple	Range three-eighths to domestic three-eighths	7.5 - 9.0	25.6 - 30.0
56s	Three-eighths clothing		Under 7.5	
46 - 50s	One-quarter staple	Eastern three-eighths to one-quarter staple	7.5 - 10.0	30.1 - 35.1
44s	Low one-quarter staple	Low one-quarter	10.0 - 17.5	35.2 - 37.0
36 - 40s	Coarse	Coarse	10.0 - 17.5	37.1 up

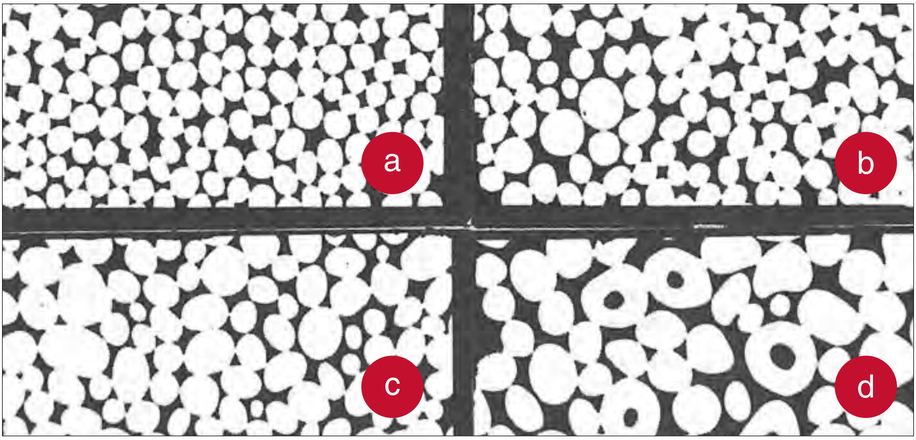

Fig. 2. Cross-sectional views of fibres showing (a) uniform diameter and shape in fine wool, (b) non-uniform fine wool, (c) non-uniform coarse wool, (d) medullation (center of fibre with air spaces).

Length of fibre

Good length of fibre is essential for the production of a superior worsted yarn. Length of fibre is determined to a large extent by the breed of sheep; that is, it is largely an inherited factor, but it can be influenced by nutrition. Experiments have shown that a high plane of nutrition will increase the fibre length by as much as 170% of that produced on a low plane of nutrition. For maximum production the animal must be well fed.

The following minimum, unstretched lengths are required for the various grades of wool before they can be classed as “staple wool.”

Fine staple	5.0 cm
One-half staple	6.5 cm
Three-eighths staple	7.5 cm
One-quarter staple	7.5 cm
Low one-quarter staple	10.0 cm

Strength of fibre

To withstand the stress of manufacture and produce a strong, long-wearing fabric, wool must possess tensile strength. To be classed as a “strong wool,” a high percentage of fibres must pass through the carding, combing and spinning processes without breaking.

Canadian wool produced under normal range conditions, where the sheep have received sufficient feed, usually has adequate strength. However, there are two conditions that may cause a lack of strength. One condition is known as "tender wool," i.e., fibre that is weak throughout its entire length. This is usually due to the sheep having some chronic disorder, being on a low plane of nutrition for an extended period, or being old. The second condition is a break, or definite weak spot, at a particular location on the fibre. This is noted readily when the wool is stretched, as it breaks squarely across the staple. Sudden illness, starvation during a bad storm, or overfeeding of concentrates, are mainly responsible for this condition. There can also be some difficulty experienced with a fleece break at lambing time. For this reason, it has become common practice to shear as soon as possible before or after lambing so that shearing will occur at the break; thus the effect of the break will not be apparent in the fleece.

Crimp

Crimp is the term used to designate the natural waviness of wool fibres. The number of crimps will vary from 1 to 30/2.5 cm, depending on the degree of coarseness. More crimps are present in the finer wools. Well-crimped wool will spin more easily and produce a finer and stronger yarn with less wastage than a poorly crimped wool. Uniformity of crimp is associated with uniformity of fineness and length, and is a sign of superior quality.

Colour

The normal colour of wool from the improved breeds of sheep is white, but a small percentage of it may be brown, black, or grey. Generally, manufacturers demand that the wools used in processing be scoured out completely white to ensure that the future colour of the fabric will not be affected by the natural colour of the fibres. **The presence of dark or off-colour fibres in white fabrics causes them to dye unevenly and, in addition, makes them unsuitable for pastel colouring.**

The black-faced breeds, for example Suffolk and Hampshire, tend to have black or brown fibres mixed with the white portion of the fleece on their legs and head, and occasionally throughout the main portion of the fleece.

Felting properties

The capacity to felt, one of the characteristics peculiar to wool and only a few other hair fibres, is attributed primarily to the presence of scales on the surface of the fibre and to its crimpy nature. Under the influence of heat, moisture, alkali and pressure, the fibres form a wool pad, or cloth, that can be used for wearing apparel. Common items illustrating this type of manufacture are felt hats, felt boots, felt socks and felt cloth. Woven goods may also be subjected to manipulation and pressure in hot, soapy water to produce a felt surface. This process of finishing cloth, known as felting, is commonly employed in the manufacture of melton and billiard cloth.

Elasticity

Elasticity is the ability of wool to return to its original form after having been forced out of shape by pressure. This is one of the peculiar characteristics of wool that makes it superior to other textile fibres. Yarn from highly elastic wool can withstand the stress of manufacture more readily, and the garments produced will hold their shape better than those produced from wool lacking this property. In general, fine wools are more elastic than coarse wools.

Yield and shrinkage

Yield is the amount of clean wool that remains after scouring, expressed as a percentage of the original grease weight. For example, a 4.50-kg grease weight fleece producing 2.25 kg of clean wool has a yield of 50%. In other words, yield represents that portion of the raw fleece available for manufacturing purposes. Shrinkage is the weight that wool loses when scoured, expressed as a percentage of the original grease weight. Shrinkage results mainly from the removal of dirt, manure, seeds, burrs, chaff, straw, sweat salts and wool grease. Because wool processors are interested only in the quantity of clean wool present in the clips they buy, they are able to pay proportionately more for the lighter-shrinking wools.

Information available from testing wool

Commercial lots:

- Average fibre diameter (micron and grade)
- Standard deviation of fibre diameter
- Coefficient of variation
- Percent clean yield
- Vegetable matter present (grease basis)
- Histogram of fibre diameter distribution
- Length and strength (position of break)

Individual animal tests:

- Average fibre diameter (micron and grade)
- Standard deviation of fibre diameter
- Coefficient of variation
- Percent clean yield
- Histogram of fibre diameter distribution