Estimating Yield

by Linda Fox, Goat Knoll Farm, Dallas, Oregon

Yield is one of the important traits we look for in our cashmere fleece. How much cashmere does the fleece contain? Raw fleeces of equal weight may contain very different quantities of cashmere. Yield is generally indicated as a percentage, the amount of cashmere by weight contained in the fleece. A 30% yield would indicate that 30% of the raw fleece is cashmere. A 580 gram fleece with a 30% yield would contain 174 grams of cashmere, or about 6 ounces. This amount is often referred to as "theoretical yield." Even though this yield number represents the amount of cashmere contained in the fleece, it will not be the amount you obtain from a commercial dehairer, or probably even from your own careful hand dehairing. Some cashmere will be lost in the separation process. However, the theoretical yield is still a good number to have.

I consider cashmere yield one of the "big four" cashmere factors - cashmere diameter, style, length and yield. Unless you have an obsession for a particular cashmere color or a penchant for long-haired goats, your "big four" factors will likely be the same as mine. These factors determine our likelihood of hanging on to a particular goat (vs culling) and will influence our breeding decisions. So, how do we non-experts determine yield? Other than a big fat guess.

Yield can be subjectively measured just like diameter and length. Normally a person judging yield will not indicate a percentage; a judge or classer will only assign a label of "Low", "Average", or "High" yield.

Three of our "big four" can be objectively measured. Cashmere diameter can be measured by sending a sample of the fleece to Yocom-McColl or one of the other testing places. A recent study by Lupton, Pfeiffer and Dooling (summary printed in 3/99 CM) indicates that a new objective test for style may be useful. Length can be measured by anyone using a ruler.

I remember our second year's harvest of cashmere in 1996. We had Terry Sim shear and grade our fleeces. He filled in his grading sheets (form and key on next two pages) with his judgements of diameter, style, length, yield and other information about each of our goats. After he left, I weighed the fleeces and added that measurement to the sheets. I noticed that the final column on his grading sheet was titled "Est'd Down Wt." Before I sent our harvest off to the Co-op, I wanted to know about how much cashmere we had in our fleeces. I wanted to know this to estimate the amount of cashmere that we would be paid for and also just because I like to play with numbers. So I computed an Estimated Down Weight to add to the sheet. To compute the yield, I used the Co-op's estimates of yield. Their Key to the appraisal form indicates:

L	Low yield	under 20%
A	Average yield	20 - 35%
H	High yield	over 35%

I used 20% for Low, a middle of the road 27% for Average and 35% for High yield. When I received my check and data back from the Co-op, my cashmere weight totals were within a few ounces of their calculations. This enabled me to be fairly confident that my method for computing cashmere production per goat was fairly accurate, or at least my overall total was in the ball park even if the individual calculations were off.

My method for determining cashmere production was only possible because I had an expert's estimation of yield. What if you don't have this? There is another way. There is an old article published in CM, January 1995, by J. D. Winter, B. J. Restall and D. De'ath entitled "Estimation of Down (Cashmere) Yield in Goats Using Fiber Length Measurement." This article illustrates a method of estimating cashmere yield by using only the length measurement of the cashmere and of the guard hair.

Research was conducted in the early 1980's in Australia, using 68 unselected young feral goats to develop a method and a formula for computing yield using only fiber length measurements. The article mentioned ongoing research (in 1995) on 1,500 goats of varying age groups that was currently being analyzed and updated, but I can find no traces of later published research on this, so I'll just use what is contained in the original paper.

The magic formula for determining yield is:

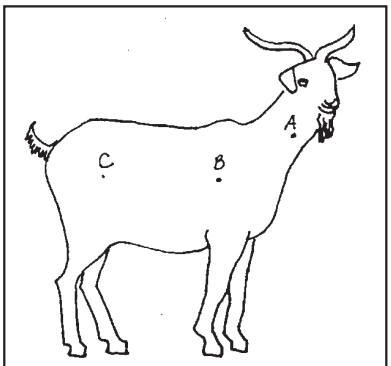
$$Y=0.3925C - 0.7315 + 0.324(C)2 + (85.54/G)$$

Y = yield of down as a percentage
C = mean down length
G = mean guard hair length

When the researchers applied this formula and compared their results to objectively measured yield, there was a correlation coefficient of 0.86. This is good; there is a high correlation between the formula-derived results and the tested results. The expected error by using the formula is ± 2.15%. Considerably more accurate than a big fat guess.

The use of this formula will enable you to calculate your amount of cashmere using three easily measured factors—the weight of the fleece, the length of the guard hair and the length of the cashmere.

What? I hear you mumbling something about the cashmere and guard hair length not being the same over the course of the entire goat. No problem. The article recommends that you take three samples of both types of fiber from the goat at three specified locations—see specified locations numbered A, B and C indicated on the goat next page.



Sample sites on the goat - take a sample of cashmere and guard hair from sites A, B, and C, measure them, and average the three.

You will compute an average, both for the cashmere and guard hair. These averages will be inserted into the formula at left and then you solve the equation for Y—which is easier said than done. Y will be the calculated yield percentage which you can then multiply by your total fleece weight to have an estimated weight of cashmere produced by each of your goats.

Producers who are computer spreadsheet savvy can create a spreadsheet with columns to insert their six individually measured lengths and the total fleece weight. The spreadsheet will compute the yield and the calculated amount of cashmere.

Or, if you'd really rather not play with Excel and have better things to do than deal with a sheetful of numbers, never fear. The researchers created a table (this page) that you can use to arrive at a similar conclusion. The chart uses centimeters, so you'll either have to take your measurements in centimeters (those little lines on the other side of the ruler...) or go ahead and take your measurements in inches, average the inches and then convert your average to centimeters (1 cm = .3937 inches). To use the chart, look up the average cashmere length on the bottom of the chart, and find your average guard hair length on the right side of the chart. Follow the two lines into the chart, and where they intersect is the approximate yield percentage, which is listed on the top.

Estimating yield

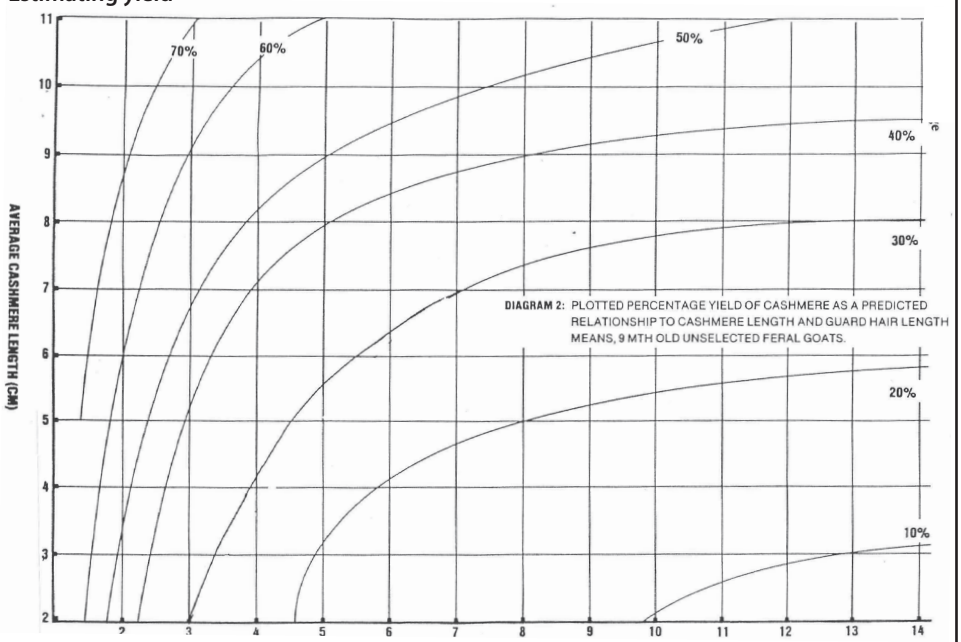


Chart for computing estimated cashmere yield as a percentage of a total shorn fleece - find the average cashmere length (in cm) on the left, and the average guard hair length (in cm) on the bottom. Where the two lines intersect, read your estimated percentage on the right of the table.

A spreadsheet (don't you love 'em?)

Remember how I said that the spreadsheet-inclined could make the computations a lot more fun? After I mentioned that idea above, I was so excited that I left the first part of this story on the computer screen, took my clipboard, ruler and postage scales and rushed to the room above the garage to weigh and measure fleeces. I already had an average measurement for the cashmere fibers, determined when we had shorn the goats, but had not yet weighed the fleece or the measured the guard hair.

I took measurements from each bag on three random grabs of guard hair. I knew my results wouldn't be perfect as I had no clue where on the goat each guard hair sample had grown. I could easily have pulled three samples from the leg or two from the neck and one from the rear. But, at this point, with the fleeces off the goat and in the bag, I had no opportunity for anything else—unless I wanted to spend a lot of time laying out each fleece and trying to figure out where each section had grown—and I didn't as I had a story on the screen to finish!

On the next page is my spreadsheet created for the purpose of allowing me to enter the six measurements and one weight, and then have the spreadsheet compute the rest for me. It works wonderfully. In addition to using the formula to compute the percentage yield, I added a column to display the amount of cashmere weight in grams. Not being able to stop there, I totaled everything in sight, converted the grams to ounces, and then to pounds and computed an overall average yield. For my sample of 17 fleeces, weighing a total of 5,876 grams (or 13 pounds), using the formula, my average yield is 29%, and the estimated cashmere produced by these 17 goats is 61 ounces, or about 4 pounds.

I was curious if this formula-driven method would come close to my earlier method of calculating yield and since I could just add to my existing spreadsheet to check this out, I did. I did not have the value of an expert eye to determine the yield, but when we sheared and graded our fleeces this year, we had made our own guess about the yield, using the Low, Average and High designations. I again used 20% for Low, 27% for Average and 35% for High yield and calculated more columns. By extending these values, I arrived at a different set of yield numbers. Some were fairly close to the

formula yields and some were quite different. Overall, my computed percentage of yield was 1% less, and total cashmere weight was 3 ounces less. Not bad, but I would feel more confident about using results for the individual goats if most had been closer to the formula-calculated yields.

Farm Name:	Goat Knoll											
Estimated Yield of:	17 Selected fleeces 2003											
Date:	6-8-03											
	Fleece	Guard Hair Length			Cashmere Length			Est	Estimated	My	Est	Est
Fleece ID	Weight	A	B	C	A	B	C	Yield	Cashmere	Yield	Yield	Cashmere
W96 Pearl	199	4	4	2.5	1.25	1.25	1.25	25%	49	L	20%	40
W20 Nichelle	542	5	4	3.5	1.5	2	2	22%	117	L	20%	108
R34	435	5	3.5	5	1.5	1.5	1.5	20%	85	A	27%	117
Fancy	515	2	3.5	2	2.5	2.5	2.5	36%	188	H	35%	180
B38 Twinkette	318	2	2.5	1.5	2.5	2.5	2.5	45%	143	A	27%	86
Buster02	683	5	4	2.5	4	4	4	28%	194	H	35%	239
UB40	316	3	2	3	2	2	2	33%	106	A	27%	85
W85	214	5	2	1.5	2.5	2.5	2.5	32%	69	A	27%	58
W74	307	1.5	5	4	1	2	3	26%	79	L	20%	61
W76	238	4.5	4	3	1.5	2	2	23%	56	A	27%	64
R59	359	2.5	2	4	2.5	3	3	33%	119	H	35%	126
W83	185	5	2.5	1	2.5	2.5	2.5	32%	60	A	27%	50
W91	270	2	3	2.5	3	3	3	38%	101	A	27%	73
G12	147	2.25	2	2	2.5	2.5	2.5	43%	64	A	27%	40
W54 Shelton	303	4.5	3.5	4	2	2	2	23%	69	H	35%	106
R50 Mufassa	603	6	6	5	2.5	2.5	2.5	17%	105	L	20%	121
W62	242	2	2	1.5	2.5	2.5	2.5	49%	118	H	35%	85
Total in grams	5,876								1,723			1639
Total in ounces	207								61			58
Total in pounds	13								4			4
Average yield									29%			28%

Next year, I will take data samples from the goat when we shear and compute a truer value using the formula and test my quickie method against that, to determine which method we will use for future estimates of yield. If the results are similar on an overall basis, I will probably resort to my quickie method as it involves gathering less data. However, if you are more concerned about the amount of cashmere produced by each individual goat (and you probably should be), accuracy on an individual basis would be as important as the overall total.

Other Issues

As pointed out in the 1995 article, this formula was developed using 9 month-old Australian feral goats, unselected for cashmere production and the results obtained from their study may not apply to different herds or different ages of goats. Also, as you've probably noted, the formula is designed for shorn goats. You combing people will have to come up with your own formula.

At a classing clinic I attended in October 1997, Ann Dooling mentioned a method of determining yield developed by the Australian using the relative lengths of cashmere and guard hair. I believe that she was referring to this formula method described here. She said the formula was based on a standard rate of primary vs. secondary follicles and that she didn't believe the formula to be very accurate as the S/P ratios are not the same for all goats.

If you are using a yield estimating method of any sort to determine the weight of cashmere you have in order to monitor the performance of a dehairing/processing company or to check the accuracy of an outside entity who may be purchasing your cashmere based on weight, consider the limits of your methods and the differences between "theoretical yield" and "actual yield." Many companies who purchase your cashmere, pay you on the basis of the amount of cashmere that will be usable after their processing procedures. Cashmere is always lost in processing, so even if your yield estimating methods produces a totally accurate amount of cashmere in your clip, your calculated amount will be less than the amount you will be paid for. Also, if you have your cashmere dehaired and/or made into yarn, there will be processing losses here as well. So, your calculated number will be lower—how much lower is acceptable is a decision you will need to make.

This doesn't mean that your calculated information is not valuable. With an estimated amount in hand that you believe you have produced, you can monitor and compare the processing losses of various companies.

You will also be more aware of the individual production of each goat, rather than merely looking at the total production of your herd. Maybe the yield number in itself isn't such an important number, but using it will allow you to compute the cashmere production per goat. A goat with a 600 gram fleece, with a 20% yield produces about 4 ounces of cashmere. A goat with a 200 gram fleece, with a 40% yield produces the same 4 ounces.

You will need your own copy of the Microsoft Excel program in order to use it.

Author's update notes, January 2013

This article was written in June 2003. Since that time, the style test noted above is common and available at testing laboratories. Also, when this article was written, most cashmere farms/ranches of any size sheared their goats. Now I believe that the most common method of harvest is combing.

This article primarily addresses yield for shorn fleeces. Yield is still important for a combed fleece, but you would be dealing with the yield after the harvest—the issue is how much cashmere vs guard hair you have in the bag, rather than on the goat. This percentage would have as much to do with harvesting methods and timing of harvest as it would have to do with characteristics of the goat. For my combed fleeces, when I'm trying to compare one goat to another, I tend to think of the yield percentage of all the bags as equal and rate them on the total weight of the harvested fleece. It would probably be more accurate to come up with a high/medium/low percentage for the combed fleeces—perhaps based on guard hair length or perceived "hairiness" of the fleece in the bag. This percentage would be used to multiply times the total harvest weight in order to calculate cashmere weight produced by each goat.