CASHMIRROR

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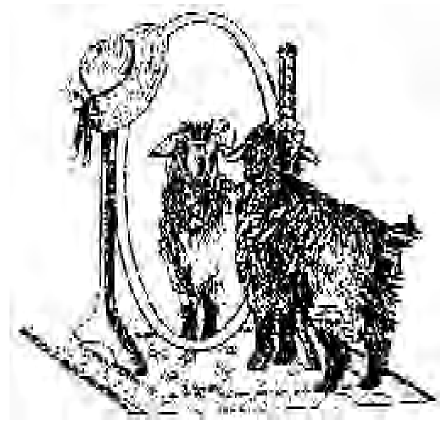

C A S H M I R R O R

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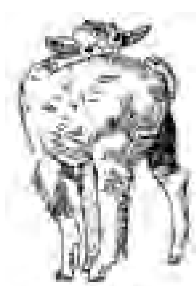

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The *CashMirror* welcomes contributions of articles and photographs and even ideas for our pursuit. Submissions may be made by mail, fax or e-mail.

No responsibility will be taken for material while in transit or in this office, although we will certainly be real careful.

Cover photo:
Linda Fox
Goat Knoll, Dallas, Oregon
"Quinn"

"Looking for does in all the wrong places."

"You rang?"

We Salute the Boys!

Finally! They are getting some attention! After the long winter watching us coddle those pregnant does and after the long spring watching us play with those cute kids, it is at last their turn—if only for us to check them out, to rate them and decide who the lucky fellas are who get the "chore" of breeding this year. So, bring them up from the far pasture, hold your nose if you have to, but let them know that they, too, are valued members of your cashmere team.

Herd Code Update

October 2002 - August 2003

HSC
Holly Spring Farm
Kathy Oliver
Powhatan, Virginia

SGF
Spring Gate Farm
Jane H. McKinney
Barboursville, Virginia

SOJ
Sojourners Station
Ken & Lisa Beckrich
Portage, Michigan

These new herd codes are an addition to the complete herd code list printed in the April 2002 issue of CashMirror.

If you want to register a herd code, contact the keeper of the codes:

Marilyn Burbank
PO Box 2067
Rogue River, Oregon 97537
541-582-4593
email: stoneore@budgetusa.net

A Message from the Boys:

"If you want some of these—"

"—You're going to need us!"

Early Breeding?

Refractions

by Paul Johnson

I am in favor of early breeding so we can have babies by the first week of January. Reasons:

1) Bigger goats for Live Goat Shows (why are they called Live Goat Shows? Does some demented person hold Dead Goat Shows?) Even though the judges usually ask contestants for ages, it's hard not to be impressed by a larger goat.

2) More fleece for said "Live" goat shows (maybe).

3) Culls can be weaned by Easter for m_ _t sales.

4) Eliminate danger of shearing in final months of pregnancy, avoiding risk of abortions.

5) Fewer (no) flies or other buggie-type pests earlier in the year.

6) Mothers can be monitored more closely as they seem to hang closer to the barn in the winter.

7) Weaning is done earlier so I can take a spring vacation!

8) Longer period to grow in size for first fleece—larger goat, more fleece?

8.5) So we can have babies at Christmas for the relatives to enjoy.

9) More time in the winter to ~~play~~ work with babies. Summers are busy with other activities.

9.5) So I have someone to talk to besides Mickey while I'm hanging around the barn waiting for spring to arrive.

10) Just because I can't wait any longer for babies!

Despite what the Vulcans say, sometimes emotions outweigh logic. I simply can't wait until logic dictates we breed.

Besides, as you can see by the date you receive this issue, I seem to have lost the argument (again).

Reflections

by Linda Fox

Paul and I have this debate every year, staring in the early fall when our first doe shows an interest in the "big smellies." Paul wants babies early, by Christmas at the latest. I like to think that I am the voice of logic and reason—not that logic and reason is everything, but it certainly deserves a passing nod (Paul!).

Our climate is temperate, so weather reasons for later kidding are not factors. In the olden days, when I made my living preparing tax returns, we always planned for kids to be born the last two weeks in April. Now that my accounting attention is spread more evenly throughout the year, I can focus on other reasons for planning kidding.

In order to maximize fleece growth on the doe, she should not be growing cashmere and kids, or cashmere and milk at the same time. A cashmere goat typically grows cashmere between the longest and shortest days of the year (June 21st - December 21st), most of the growth of the fetus occurs during the last 6 weeks of pregnancy, and a doe would be producing milk for her kids for about 3 months after birth. Also, we shear near the first week in February and it is undesirable to shear a extremely pregnant goat—we have seen a few abortions in our herd when we have done this.

Using these facts, the best time for kidding on our farm would be March 1st to April 1st. Five months prior to these dates would be September 1st to October 1st. (Yipes! That's now!) Kidding would occur one to two months after shearing, and late pregnancy and lactation would not coincide with fleece growth.

This year we had kids born at three different times—a few late December and early January, more in March, and a few in April. By the time we weaned that last batch of kids (last month) we were truly tired of keeping track of when we had to do what! It was also difficult to compare the kids to each other due to their differing ages.

My advice: Even if you lose the argument for when you want your kids to arrive, you might want to stick to your guns about having your does bred at the same time to make kid care easier.

Another hint: If you can extend the argument long enough, you will win by default!

"When do you want me to arrive?"

Moving at the Speed of Goat

By Clifford Agocs, Pennsylvania State University

"The American wants to pull hair off your goats." The translator spoke in Mongolian, signaling toward Lincoln Rodgers. The Mongolian herders smiled and gave him funny looks, but agreed, knowing that it was somehow supposed to benefit their herds.

"The herders would tackle as many goats as we had time for," Rodgers explains, "and hold them down while I plucked a tuft of hair from each of them with a small pair of pliers." He would place each sample in a plastic bag along with a packet of silica gel, like you find in new shoes, to keep it dry and prevent rot.

"Yes, they thought it was kind of," he pauses, "odd, but they were happy to do it." The samples of hair that Rodgers carefully labeled and stored were a source of genetic material - and the reason he had traveled to the Gobi Desert. In a sense, anyone who goes to the Gobi Desert goes there for goat hair - in particular, for the one kind that's fine enough to be designated cashmere.

Cashmere is crucial to the Mongolian economy. As the nation's major agricultural export, it grosses nearly $80 million each year. When Rodgers arrived there in October 2000, a non-profit agricultural assistance agency called Agricultural Cooperative Development International/Volunteers in Oversees Cooperative Assistance, or ACDI/VOCA, was overseeing a cashmere-goat breeding project, begun in 1995. Rodgers, then an 18-year old honors student in Penn State's College of Agricultural Sciences, volunteered to sample DNA from herds that were selectively bred, as well as from herds not part of the breeding program, then use genetic markers to determine how much progress had been made.

The Altay mountain goats of Mongolia, like many other mammals, have an outer coat of guard hairs to protect them from the weather and an undercoat of fine hair to provide insulation. In the spring the herders harvest these fine hairs, by brushing the goats, and sort them. To be designated as cashmere a hair must be less than 17.5 microns in diameter (less than seven ten thousandths of an inch). Next to it, human hair, with an average diameter of 100 microns, seems coarse. Hairs that are thicker than the international standard for cashmere are classified "cashgora." Still downy, these fibers are worth only one fourth the market value of cashmere. They are used in look-alike cashmere goods, though they come from the same animals.

"Any goat can produce cashmere," says Rodgers. But some breeds produce very little. All goats produce a certain amount of cashgora as well, but by selective breeding the agricultural agency hoped to increase the ratio of the finest, most valuable hairs.

Before the breakup of the Soviet Union in 1991, Mongolia had communal herds that were brought together for breeding. Breeding records were maintained in Russia, which also supplied about $400 per capita in annual aid. When the U.S.S.R. collapsed, the Mongolians lost this agricultural assistance and their major customer for cashmere. The goat herds were privatized and divided among the nomadic herders; breeding records lapsed. As the Mongolian herds became mixed, the quality of the cashmere began to decrease.

The new buyers came primarily from China, where cashmere is also produced. The Chinese traders profit from the Mongolian surplus because native traders cannot afford to pay the herders as much. Since prices were good, the herders saw no problem with their goats - after all, there is only 4.5 microns of difference between the cashmere and cashgora. If, when sorting the bundles of fibers after purchase, the traders found more cashgora than anticipated, they did not complain: They were already making a good profit.

Because of this pricing system, the herders had little incentive to improve the quality of the cashmere through breeding. Instead they preferred to breed larger goats to provide more meat and skins. Oddly, in cashmere goats, body size is negatively correlated with fiber diameter. Larger goats mean fewer profitable fibers.

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At milking time, the goats lined up and student Lincoln Rodgers weaved among them, pulling out tufts of hair. Later he would extract DNA to gauge the breeding program. ***Photo by Lincoln Rodgers.***

The Speed of Goat

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By the year 2006, ACDI/VOCA predicted that the quality of Mongolian cashmere would drop below international standards, resulting in a loss of $25 million a year. To prevent this, the breeding scheme identifies the top ten percent of males and breeds them to the highest quality females.

When Rodgers first decided to go to Mongolia he didn't know what he'd be doing. "It was an idea that came from my interest in genetics and livestock," Rodgers says, "I thought, 'Mongolia must have some interesting genetics.'" He talked it over with his thesis adviser, Guy Barbato, a professor of poultry science, and together they formulated an idea. Rodgers learned from the U. S. Department of Agriculture that he could transport hair from Mongolia without the expensive permits that would be required for blood or tissue samples. So he decided to collect hair samples from some type of livestock and examine genetic differences.

In Mongolia he rented an apartment from a family of missionaries in the capital city of Ulann Bataar (pronounced OO-lan ba-TOOR). The English-speaking population in the city is small. Beginning with the U.S. embassy, he soon made connections with people involved in agriculture. "Once I started asking questions, it was easy to get in touch with the foreign aid community," Rodgers explains. His research plan, he learned, was perfect for assessing the progress of the ACDI/VOCA breeding scheme.

It was difficult to determine by looking at the goats and their fibers whether progress was being made. However, because goats mature at three years and three kids can be born to a doe in a two-year period, the agency thought that enough time had passed to show genetic distinctions between the herds. Yet data on goat DNA is not common, and neither are samples of hair from those breeds that wander the Gobi Desert. Rodgers became the agency's connection to a state-of-the-art genetics lab at Penn State, while being admitted to a place where luxury is produced by patience, thrift, and a constant struggle with the elements.

In Mongolia no one wears cashmere. Mongolians tend to have only a few clothes, which they wear for a while and then sell or trade. They have the opportunity to buy new clothes (new to them) when they live near towns, which is only for a small part of the year. The rest of the year, these nomads are following the goats to rough pastures. Just as the goats provide a use for the otherwise coarse landscape (they thrive on a much wider variety of vegetation than cattle or other livestock), they also provide almost everything that their herders need to survive in the Gobi Desert. Along with horse, sheep, and yak, a herder may have hundreds of goats. "They think of their animals as a walking bank account," Rodgers explains. The sheep provide wool and the horses are used for transportation, but all the animals, including the goats, provide dairy products, meat, skins, hair, and even dung.

Nomadic Mongolians don't wear the cashmere they harvest from their goats. Used American clothes, traded en route, are much more popular. ***Photo by Lincoln Rodgers.***

Mongolia is land-locked; most of the rain has dropped on Europe and west Asia before reaching the higher elevations of Mongolia, making the Gobi a barren land with none of the tempering effects of water. The winds are high in the absence of trees, and wood is too scarce to be burned. The Mongolians make use of dung, which has no more clearly desirable use than as a fuel.

Their goats are constantly producing it where they pasture, and the herders rake it up into large baskets which they carry on their backs. They then lay it out to dry in the sun. During his 17 days of travel through the Gobi, Rodgers became skilled at building a dung fire. "It doesn't smell bad like you'd think it would," he says. "I guess I began to associate the smell with being warm, so I liked it." While he was there the temperature rarely rose above freezing.

In the winter these dung fires are constantly burned inside each family's ger. A ger (the Russian word is yurt) is a dome-like wooden structure that can be up to 20 feet in diameter. Its edges are 4-foot high walls made of lattice that can be folded and easily transported. The top is designed like a wagon wheel, rising to about 8 feet at the center, from out of which spews the smoke of the dung fires. The gers are completely portable down to the removable floors of wood or tile. The ger is insulated with layers of wool and canvas tucked under the floor to protect its inhabitants from the weather, giving the effect of a large white dome. Against the sepia landscape a ger stands out among miles of otherwise empty, rocky terrain.

"If the Gobi Desert were in the United States," Rodgers says, "we would make it a national park and stay out of it." The Mongolians, however, use it to its fullest extent. For generations their lives have been dictated by the demands of the goat. Many families

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have seasonal camps that they return to year after year, but they still must carry all of their possessions with them. Rodgers got used to this lifestyle, carrying a pack of only 20 pounds on his back. The herders move by the seasons, traveling only as fast as their goats and stopping where the goats find food. There they set up their gers. "Two people who know what they're doing can put one up in a couple of hours," says Rodgers. Inside, the wood is ornately painted and holds ceremonial meaning. The edges, where the ceiling is lowest, are lined with cots so that each one looks directly toward the stove which sits in the center between two upright supports. Leaning on these supports is taboo; that's just one of the customs that must be considered when meeting with the herders, but a fairly important one considering that the stability of their homes depends on it.

These customs also dictate where one may sit upon entering a ger: men to the left, women to the right, with the most senior person furthest from the door and the others moving down toward it by rank. "You have to be aware of their customs," Rodgers says, "but they're an easygoing people. If you did something wrong, one of the members of the group would correct you, but the people wouldn't get deeply offended.

"They would always offer vodka," Rodgers says, as well as pass around a hospitality dish of candy or biscuits. These social gatherings would go on before any business was attended to. "Nothing happens quickly in Mongolia."

Along with some other agency employees, including a translator and a driver, Rodgers traveled with Zagdsuren Yondon, a Mongolian native who has long been active in efforts to coordinate the cashmere industry. After the formalities, he would examine the goats and update the herders on the project while Rodgers would collect hair samples. If he was lucky he would arrive at milking time. The goats are so familiar with the process that when they are herded together they begin to line themselves up, neck to neck, in order to be tied. At these times he could get a large number of samples efficiently. Otherwise he got the herders to grab nearby goats and took a hair sample from each.

During his three weeks traveling by jeep through the Gobi Desert Rodgers was able to collect over 200 samples from five herds in the breeding project and one that was not.

After he returned to Penn State, Rodgers began the lab portion of his research project in a genetics lab in the department of poultry sciences. There, graduate student Michelle Block coached him in micro-genetics techniques. DNA extraction is typically considered "standard protocol in a genetics lab," Block says. "Yet the assay is more difficult when the tissue source is a hair follicle. The primary source of DNA from Lincoln's plucked goat hairs were the epidermal cells of the follicle. These cells are few in number and are encased in a particularly sturdy keratinized sheath. In attempting to get to the DNA through the sheath, it was easy to damage the DNA. Overcoming this obstacle requires a great deal of time, effort, and goat hair."

During the spring semester of 2001, Rodgers met with Barbato daily to consult on the project, and spent 30 to 40 hours a week working in the lab devising a procedure to get at the DNA and deciding what to look for once he had it. DNA to a geneticist is something like a word jumble to a native speaker: the desired information is there, but it is complicated by a lot of unintelligible gibberish.

Drawing on previous studies of the goat genome, Rodgers selected ten DNA markers, specific sequences located at a known place in the genome. The ten occurred on different chromosomes, limiting the influences one trait would have on another. He looked for these markers by running the goat DNA samples through a Polymerase Chain Reaction, or PCR machine. This machine uses small synthesized pieces of DNA called primers to find a specific DNA sequence. If these sequences (in this case, the markers) are present, they will be copied thousands of times. All the copies are then separated by size in a gel which has an electric current running through it. Large pieces of DNA pass through the gel more slowly, while small pieces more quickly. Pieces of the same length flow through the gel at the same speed and so form a visible band. By comparing the band patterns, Rodgers could, in theory, tell how closely related two goats were and see how much progress had been made in establishing a distinct high quality herd.

However, the PCR tests showed only faint bands; and these were inconsistent even for the control markers - markers that should be present in any goat. This result meant that the DNA itself was damaged. The PCR primers either could not initiate—or could not complete—the copying or it could not be completed.

Rodgers's methods for extracting the DNA had included microwaving as well as chemical treatments. Some of these methods, he believes, may have agitated the DNA too much. After a semester of work in the genetics lab, he was only able to send preliminary information back to ACDI/VOCA.

"As goat hair is not an abundant source of genomic DNA, Lincoln eventually came to a point where he simply did not have enough DNA to test all of the primer sets," Block says. "It really was more than an honors project, " she adds. His attempts to establish a breeding record based on genetic data for herds of animals which have been little studied would have been more suited for a master's degree. "Lincoln really did a lot of groundwork research on the breeding," she says. "His work will benefit future studies."

The project begun by ACDI/VOCA established three central herds of high quality goats, spread across 78 herder households and including over 6,000 animals, and led to the establishment

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of the Superior Goat Breeders "Millennium Quality" Association. With Rodgers' Mongolian traveling companion, Zagdsuren, as its president, this group is currently working independently to expand into other provinces, and into more herds. ACDI/VOCA completed their work on the project in September of 2001.

According to Zagdsuren, the average cashmere diameter has improved by 0.6 microns on goats bred as a result of the ACDI/VOCA project. The Millennium Quality association also links the herders to each other as well as to international contacts, and gives them access to market information. Finally, the association links the nomadic herders with agricultural developments, such as genetic research like Rodgers's into the code that makes goat hair into cashmere.

Lincoln Rodgers received a B.S. in agricultural sciences in December 2001, with honors in agricultural sciences and a minor in international agriculture, from the College of Agricultural Sciences and the Schreyer Honors College. Rodgers's travel expenses were funded by the Schreyer Honors College.

CDC: West Nile Virus— What Everyone Should Know

West Nile Virus is now in most of the United States. Most people become infected through the bite of an infected mosquito. You can reduce your chance of getting infected by avoiding mosquito bites. Adults are at highest risk. People over age 50 have a higher risk for becoming seriously ill when they get infected with West Nile virus. People under age 50 can also become sick, but it is less likely.

Most people who get infected with West Nile virus do not have any symptoms. Some people develop a mild illness called West Nile Fever. This mild illness gets better on its own. No treatment is needed. A small number of people (less than 1 out of 100) who get infected with West Nile virus develop severe disease, called West Nile encephalitis or West Nile meningitis (inflammation of the brain or the area around the brain). This severe disease usually requires hospitalization. In some cases, especially among older persons, it can result in death. Symptoms of severe illness include headache, high fever, stiff neck, mental confusion, muscle weakness, tremors (shaking), convulsions, coma, and paralysis. See your doctor if you develop these symptoms. There is no specific treatment for the West Nile virus infection. There is no vaccine available for people.

There are three ways to reduce your West Nile Virus risk: **Avoid mosquito bites**! Wearing long sleeve shirts, long pants and socks sprayed with repellent while outdoors can further help prevent mosquito bites. Avoid mosquitoes! Many mosquitoes bite between dusk and dawn. Limit time outdoors during these hours, or be especially sure to use repellents and protective clothing. Spray! Spray insect repellent containing DEET on exposed skin when you go outdoors. Spray clothing with repellents containing DEET or permethrin. Products with a higher percentage of DEET (up to 50%) give longer protection. Don't spray repellent on skin under clothing. Don't use permethrin on skin. Use repellent carefully! Repellents containing DEET are very safe for adults and children when used according to directions. Don't put repellent on kid's hands because it may get in their mouth or eyes.

Mosquito-proof your home! Keep mosquitoes outside by fixing or installing window and door screens. Drain standing water—Don't give mosquitoes a place to breed. A small amount of standing water can be enough for a mosquito to lay her eggs. Look around every week for possible mosquito breeding places.

Empty water from buckets, cans, pool covers, flower pots and other items. Throw away or cover up stored tires and other items that aren't being used. Clean pet water bowls weekly. Check if rain gutters are clogged. If you store water outside or have a well, make sure it's covered up. Encourage your neighbors to do the same.

Help your community! Dead birds help health departments track West Nile virus. Check with local or state health department to find out their policy for reporting dead birds.

Safe (Goat) Sex

By Linda Cortright, Grumble Goat Farm, Union, Maine

My mother taught me to always write a thank-you note. No exceptions, excuses, or procrastinations; thank-you notes were non-negotiable. I feel the same way about safe sex. Not only does it top the list of rules for proper social engagement, but imagine the consequences if you slip up?

Here on Grumble Goat Farm, we practice safe sex. I frequently lecture the goats on the importance of protected intimate relations. Oh, occasionally the goats complain that taking these precautions can ruin the moment or interfere with spontaneity—as if there's any other kind with goats? But for the most part they oblige and I have had no unwanted pregnancies—mother would be proud.

This past December I fell in love. Love at first sight, just like in a Harlequin romance or a mind-numbing soap opera. He was young, well-built, a man's man and a charmer with the ladies. He had hair like an ad for pricey salon mousse and bangs like a polished Elvis impersonator. Although he lived two towns away I knew he could be mine for a price and I was willing to pay. But before I could say, "Do you take plastic?" a dear friend surreptitiously purchased Master Jasper and presented him as a birthday gift. (Forty-five years old and I'm celebrating with a long-haired, horny male. Yahoo!)

I had big plans for bringing Master Jasper to live on my farm, but first, he needed a wife.

He was far too sleek and beguiling not to reproduce at least once. And pity the poor fella who is deprived the opportunity for proper consummation.

Like any good matchmaker I selected carefully. Young, virginal Estelle; petite, sweet and annoyingly coquettish. The perfect mate for this hot young stud. Vows were exchanged at Jasper's old farm. The Ceremony was brief, it was outdoors, few attended (it was winter) but it was official. Jasper and Estelle departed for their honeymoon stall o' love amidst a modest crowd of well-wishers and voyeurs.

Perhaps Estelle was nervous about her first time, or maybe it was the hand-me-down peignoir she had hurriedly packed, but after two days, their virginal status remained unchanged. I became increasingly concerned that there was something amiss. Was there no chemistry? Too much eau de buck? But by the third day, magic; Jasper and Estelle were in the wild throws of passion, oblivious to their surroundings. My concerns vanished. All good things, as they say, must end. After only one week, Estelle returned home and Jasper, alas, was off to the vet. No more babies for him.

Jasper's transition into my small herd two days after surgery was relatively uneventful. His new found—though recently revoked—manhood seemed to boost his confidence among the other girls. My three other wethers were unusually accommodating and there was minimal sparring and scarring.

After five months of watching the former coquette grow pleasantly plump and surprisingly content, kidding season began. I had bred only two other of my does to a different buck and each kidded in a timely manner. Jasper became the proud

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Jasper and Estelle—a cute couple!

Safe Sex
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papa of Hopkins and Holly.

I can't say that he instantly took to fatherhood. Something about the whole birthing process leaves some guys shaking their horns, feeling disenchanted by the whole icky-gooey factor. But he made a good show of it nonetheless. I invited old friends, new friends, family and strangers from the street to come and view the kids. I shared dozens of baby pictures with anyone who would stand still long enough for me to thrust them under their nose. I even offered them to the police officer while fumbling for my license.

The new kids were almost a month old when my good friend, Hatie stopped by for a visit. An experienced goat farmer and veterinary assistant, Hatie knows the ins and outs of farm medicine better than most. She is also a wizard with a spinning wheel and a pair of knitting needles and spends much of her spare time horseback riding but since she owns a mule I guess it's technically mule-riding.

I was still at the office the morning she stopped by my farm, but she helped herself to a good visit with the kids. Sorry to have missed her, I phoned later that day just to brag about my adorable kids.

"So, what did you think of those babies?" I asked, as proud as if I had just coached the winning Super Bowl team.

"Oh-my-god, they are so cute. When's that black one due?"

"Excuse me?"

"You know that black-badger-faced one," she repeated.

"Oh," say I, relieved to discover that she was referring to Esprit, one of my older goats "She's not pregnant; she's just fat."

"I don't think so," says Hatie, full of conviction.

"Nope, trust me, she hasn't been off the farm and none of my boys are intact," I reply with equal assuredness.

"Well, I don't know how it happened but you've got yourself a pregnant goat." She informs me with complete certainty.

Now mind you, she may work for a vet, and she has goats, and I know she's a wiz with fiber but they're my goats and I know who's been where and with whom.

Hattie just laughs at my illusions. "I'm telling you Linda, she's got an udder on her the size of a paint bucket."

At this point I walk over to my kitchen window and search the field for a pregnant goat. I spot Esprit. Miraculously, she appears to have a rather pendulous...

I hang up in utter shock.

I walked out into the pasture and bent over Esprit to inspect the alleged baby-belly. She was fat, all right, and I certainly didn't need years of veterinary school to know that was an udder. But how the hell had it happened? This couldn't happen to me—I practice safe sex!

I called Hatie back. I explained there was no possible way she could be pregnant. It was truly, well, inconceivable...

When was Jaspar castrated?

Months ago.

How long before I had brought him to the farm after the procedure?

About two days.

Jasper—proud Papa. He wasn't quite done yet. Now, he is!

She laughed. "Well there's your answer. He still had some live rounds left in there."

"But that's not possible, I pleaded. "He was snipped! Gone. Kaput. Finis."

And not that I believed in Immaculate Conception over an educated friend but...

By amazing coincidence, my two little bucklings were to be castrated that afternoon. I explained the situation to my vet and she agreed with Hatie that it was indeed possible for Jasper to have impregnated another female shortly after his castration. But—and I liked this theory better—it was equally likely that Esprit was having a false pregnancy.

Whew, that was a close. This was all some extreme case of hormonal hysteria. Life was again serene. After all, Esprit is getting a little long in the tooth; hardly likely to catch Jasper's young eye, especially after his marathon tryst with Estelle.

I returned from the vet, tossed the newly snipped boys back in the herd and went to celebrate our non-pregnancy with my semi-annual nap.

My relief was brief.

Two hours later Esprit began to have contractions that would make a midwife shudder. I grabbed iodine, paper towels, blackstrap molasses, and a portable phone and raced out. It started to rain so the goats ran to the barn pushing and shoving for a dry spot like commuters on a New York subway. For hours she pushed and moaned, and in-between contractions, I maintained my weakening state of denial.

It just wasn't possible. Everything I understood about reproduction—both human and caprine—seemed incompatible with the physical evidence. Finally, my denial was permanently shattered by the arrival of a single, beautiful (but of course!) baby girl.

Oh, the responsibility of a yet another baby. The midnight,

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midday, midmorning and midafternoon feedings, long years of worrying about the way she was raised... Would she be a good producer? A good mother? A fiber factory? Another spicy fajita?

And more importantly how was I going to explain my indiscretion to all the other farmers? I could hear them tittering and pointing making snide remarks about illegitimate children and lack of morals.

It was all true. I had unwittingly committed the ultimate in social indiscretions: unsafe sex. It was worse than forgetting to write a thank-you note to my old Aunt Tilly. How could I ever be forgiven? Mother was right, there is no excuse.

Hereditability Statistics for Cashmere Goats

The hereditability statistics printed at right are excerpts from the Chinese study referenced and from the article "Advanced Cashmere Breeding" by Tom Dooling, Pioneer Mountain Farm, Inc. This paper was presented at the 1996 Business of Cashmere Conference in Bozeman, Montana. The entire article is available in the BOCC Conference Proceedings book; it was also printed in the November 1996 CashMirror.

For anyone interested in the technical aspects of hereditabilities and how to plan your fall breeding to make the best use of the "odds" of passing on those good characteristics you are looking for in your kids, this article is a good summary.

Hereditability Statistics for Cashmere

Source	**1**	**2**	**3**	**4**	**5**
Characteristic					
Liveweight	.29	.26	--	.22	.39
Fleece weight	.29	.42	.45	.25	.42
Down yield	.90	.23	.30	.52	.57
Down weight	.61	.36	.38	.45	.62
Down diameter	.47	.70	.68	.83	.99
Down length	.70	--	--	--	--

Table 1. Estimated Hereditability, by 5 different research groups, of some desirable characteristics for cashmere goats.

Sources:
1. Pattie & Restall, 1987, 1989
2. Gifford et al, 1990
3. Couchman et al, 1987
4. Baker et al, 1991
5. Bigham et al, 1991

S/P Ratio, Secondary to Primary	0.534
Density of Secondary follicles	0.137
Density of Primary follicles	0.160
External diameter of Secondary	0.584
External Diameter of Primary	0.080
Internal Diameter of Secondary	0.187
Internal Diameter of Primary	0.496
Depth of Secondary	0.002
Depth of Primary	0.204

Table 2. Hereditability of various factors in cashmere goats from studies performed by Ma Ning and others (China).

S/P to Down Weight	0.680
S/P to Liveweight	0.423
S/P to Down diameter	-0.343
S/P to Birthweight	0.674
Diameter of primary to down weight	0.450
Diameter of primary to down diameter	0.489

Table 3. Correlations of various hereditable factors in cashmere goats from a study of Chinese Liaoning cashmere goats by Ma Ning, Li Yongjun, Song Yaqin, Song Xianchen and Sun Xianwei. Researchers noted that the hereditabilities of follicle density in Liaoning goats were found to be similar to the Australian cashmere goat, but that hereditability of S/P ratio in the Liaoning goat was found to be higher than that of the Australian goats.

Hereditability (Heritability)

Did you just finish looking at those hereditability tables on the last page and find yourself scratching your head a little? They certainly look important, but what does it all mean? In English. Also, why are there two spellings?

We have no clue about the two spellings, but we can provide some explanation for the rest of it. Research on cashmere goats has found some characteristics to be highly hereditable and some to be less so. Also, some traits are linked to other traits (correlated), so that by breeding for certain desirable traits in your herd, you may be inadvertently selecting for undesirable traits at the same time. It is helpful to the success of your breeding scheme if you know how likely a desirable trait is to be passed to offspring. If you have a doe with borderline cashmere, what is the chance that you can breed her to a buck with excellent cashmere and have your doe produce kids with good cashmere?

From Table 1, you can see that there is disagreement among the researchers on the hereditability numbers. Tom Dooling, in the paper referenced on the prior page, stated that the disagreement between the workers had to do with both statistical problems and experimental designs. He took an average of these differing factors and arranged the characteristics from the most to the least hereditable, as follows: Down Diameter, Down Yield, Down Weight, Fleece Weight, and Liveweight. From this order, you would notice that breeding for fine cashmere and down yield will be "easier" than breeding for fleece weight or liveweight.

Breeding decisions based on hereditabilities are compounded by correlated characteristics. It is logical that some traits are correlated—like down weight and down length. These two factors are highly correlated; you would expect that a fleece with longer cashmere would weigh more. One correlation that is not so logical is the correlation between fiber diameter and weight of the goat. These traits are genetically linked to each other. If you breed for one, you drag along the other. If you select for only fineness of cashmere, you will probably also get smaller goats.

Tom Dooling noted that there were no researched correlations for cashmere coverage and uniformity of cashmere fleece and fiber diameter, but in his observation of thousands of animals in the US, China and Australia, he had noted that animals with the better coverage tended to have coarser cashmere (in the 16µ+ range) and were frequently even coarser on the neck, breast and shoulders. There is also no research on what Tom calls "staying power"—the ability of a goat to maintain good cashmere characteristics through the years as they age (like old "Sweet Face").

Just the Definitions

Heredity—transmission of physical characteristics from parent to offspring, determined by chromosomes living within nuclei of the cells in an organism.

Chromosomes (come in pairs)—small bodies within the cell that contain mostly proteins and DNA; they carry the species' genetic material which determines inherited physical characteristics.

Genes—Loci, or locations, on chromosome strands, sometimes referred to as alleles.

Hereditability (or heritability)—ability of a physical characteristic to be passed from parent to offspring. In genetics, this is the statistical probability that a specific characteristic will be passed on to offspring. It is referred to as a number between 0 and 1, with 0 being not very hereditable and 1 being very heritable. For example, if we find that long, floppy goat ears have a hereditability factor of 0.9 this would mean that 90% of the chance of the long floppy ears being inherited by an offspring is determined by heredity and 10% by other factors. If we breed two floppy eared goats to each other, there is a good chance that the kids will have long, floppy ears.

Correlation—a statistical number called a "coefficient of correlation." This number, like the hereditability "score" is also a number between 0 and 1 (and 0 and -1). It represents how related one trait is to another—how likely that if you get one characteristic, you will also get the other. Traits can be positively correlated (the numbers between 0 and 1) or negatively correlated (the numbers between -1 and 0). For example, suppose that the link for floppy-earedness is strongly correlated with the trait for curly eyelashes. If the correlation for floppy ears/c. eyelashes is -.8, and if you wish to select for goats with curly eyelashes, you should avoid breeding floppy eared goats. A score of 0 means the two traits are not correlated, either positively or negatively.

Primary follicles—hair follicles that produce guard hair on the goat. Secondary follicles—hair follicles that produce the down—cashmere. S/P ratio is the number of secondary follicles per each primary follicle.

SELECTION AND BREEDING SYSTEMS

By E. J. Pollak, Cornell University, Ithaca, NY

From the USDA Extension GOAT HANDBOOK

The goal of a livestock system including goats is to produce a quantity of quality products with maximum efficiency. A component in achieving this goal is the genetic improvement of goats in the areas of quantity, quality, and efficiency. Genetic improvement is achieved by selection. The rate of improvement is directly related to the accuracy with which the goats are ranked, the intensity with which they are selected, the amount of genetic variation available in the trait(s), and the generation interval. Once goats have been selected to become parents of the next generation, one must consider alternative mating plans. Various mating strategies differ in their goals, and the consequences of each should be understood when considering programs for genetic improvement.

Traits of goats can be considered either to be qualitative (simply inherited) or quantitative. Most economically important traits are quantitative.

Genetic Parameters

Quantitative traits of goats are those which are influenced by genes at many different loci (gene sites on a chromosome), each contributing a relatively small amount to the total expression of the trait. A second characteristic of quantitative traits is that their expression is influenced to some degree by the environment in which the goat performs.

The phenotype of a goat is the observable expression of some trait, e.g., pounds of milk produced in a lactation. The phenotype (P) for a trait can be defined as the sum of the goat's genetic merit for that trait (G), the influence of the environment (E) on the record, and the population mean for the trait (M). If one looks at the phenotype of several goats for a given trait, one can also determine their average performance and a certain variation from animal to animal called variance. The sum of the variances due to genetic and environmental influences makes up the total phenotypic variance, from which the standard deviation can be extracted; i.e., the standard deviation is the square root of the variance.

Average performance and standard deviation describe a trait in a given population. If a trait is normally distributed along a bell-curve, then 50% the trait's records will lie between -0.67 and +0.67 standard deviations and 95% the records between -1.96 and +1.96 standard deviations in a particular population. The ratio of the additive genetic variance over the phenotypic variance is the important parameter called heritability (h+/-), which can take on values from 0 to 1. A value of 0 means less of the variation in the trait is genetic, and a value of 1 means all the observed variation is genetic. Few economically important traits in goats have values exceeding 0.5. General characterizations for selecting traits are:

low heritability	less than 0.15
moderate heritability	0.15 to 0.30
high heritability	more than 0.30

Reproductive traits have low heritabilities. Milk and fat yields are examples of traits with moderate heritability. Milk composition and most growth-related traits have high heritabilities.

Heritability has many uses in goat genetics. For example, heritability can be used to estimate the breeding value (genetic merit) (BV) of a goat. Assume the average production of a certain breed of goats is 1000 lb (P) after adjusting the records for influences of age of doe, season of kidding, etc. A certain doe in that breed produced 1100 lb milk (P). Hence, her breed superiority (P - P) is 100 lb. The portion of this phenotypic superiority due to her genetic merit is 100 x 0.25, if the heritability for milk production in dairy goats is 0.25. Thus, her Estimated Breeding Value (EBV) is 25 lb.

The true breeding value (BV) of goats is never known and they are compared on estimates of BV, which are subject to the variance or error in estimation. Accuracy denotes how well the BV of a goat has been estimated. The more information available on an individual, either in terms of repeated records or information on relatives, the more accurate the estimated BV's (EBV), and the less likely the comparison of individuals is in error.

The EBV's can be used to rank goats comparatively for selection. In the example, the goat (A) producing 1100 lb of milk was 25 lb genetically superior to the breed average doe. Another doe (B) producing 900 lb milk is 25 lb inferior to the breed average (-100 x 0.25). Thus, goat A is 50 lb milk genetically superior to goat B.

The EBV of an individual represents its own genetic merit but greater interest lies in the merit of that individual's progeny. "How much of an individual's breeding value or superiority will be transmitted to its progeny?" is the question. The concept of Estimated Transmitting Ability (ETA) equals one half the EBV of an individual goat, since one half of her genes are represented in her progeny; the other half being supplied by the other parent. Genes obtained by one particular progeny from its parent are a random sample. A progeny may receive in the extreme a sample of the parent's best or its worst genes only. This explains why poor progeny sometimes may result from good parents and good ones from poor parents.

The genetic parameter closely related to heritability is repeatability (r). It is also a ratio of variances, namely the variance for permanent environmental influence (e.g. injury) plus the total genetic variance, not just the additive, over the phenotypic

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variance. Repeatability is equal to or greater than heritability by definition. Repeatability can be used to predict the future performance of a goat based on her past performance.

This Most Probable Producing Ability (MPPA) can be calculated as: P'+r(P-P') when the goat has one record. The doe (A) producing 1100 lb (P) in the population averaging 1000 lbs (P') has an MPPA of 1050, if r=0.50. When the goat had n records the calculation for MPPA is:

$$P' + \frac{nr}{1+(n-1)r}(P-P')$$

All domestic livestock have several traits of economic importance, and their relationships to each other are critical for selection programs. A correlation describes the relationship between two traits. There are phenotypic, genetic, and environmental correlations. A correlation can have values between -1.0 and +1.0, with zero meaning no relationship. The nearer the correlation is to +1.0 or -1.0, the closer the relationship is between the two traits. A positive correlation (+) indicates high measures of one trait tend to occur with high values of the second and low values for the first with low values for the second. A negative correlation (-) indicates a tendency for high values of one trait to occur with low values of the second. For example, milk and fat yields of goats are positively correlated. As pounds of milk per lactation increase so do the pounds of fat produced. However, milk yield and milk fat percentage are negatively correlated. As pounds of milk increase, the percentage of fat in the milk of goats tends to decrease.

Genetic correlations are important in selection and have two biological causes: pleiotropy and linkage. Pleiotropy is the result of one gene contributing to the phenotype of more than one trait. Linkage means a gene (or set of genes) is in close proximity on a chromosome to a gene for a second trait. Being close together on the same chromosome, they are passed on to the progeny together and cause the genetic correlation. Thus selection for one trait will alter also the performance of the population for all other traits which are genetically correlated to the trait under direct selection. That change in a correlated trait is called a correlated response. Some correlated responses can be beneficial in terms of improving the total productivity of goats; however, others may be detrimental. Genetic correlations as well as phenotypic correlations may be used in indexing animals for simultaneous selection of more than one trait.

Selection Response

The first step in the selection process is to define the goals of the program, e.g., which trait or traits are desired in selection. The appropriate records need to be collected on the selection candidates and their relatives. From these records, the BV's of the individuals are estimated and the goats ranked from best to worst. The breeder must now decide how many goats are needed for both sexes, and selection is then simply keeping the top ranked animals. Fewer bucks are required to maintain the population than females, therefore the intensity of selection for males can be much greater. This points out that more progress can be made by concentrating efforts on buck selection.

Table 1. Selection intensities (i) for different percentages of individuals selected to be parents from a large population.

Percent Saved	i
1	2.67
5	2.06
10	1.75
30	1.16
50	0.80
70	0.50
90	0.19
100	0

A selection differential is the phenotypic average difference of the selected parent animals (Ps) from the population average (P'). Selection intensity (i) is the selection differential expressed in terms of phenotypic standard deviations (s); i.e. the ratio of (Ps-P') over s. Selection is used in predicting genetic response due to selection because it can be related to that percent of the population saved as parents (see Table 1). If the top 1% goats available are used for selection, their mean phenotypic superiority due to selection intensity is 1.75 standard deviations above the population mean. If the top 70 are selected then the selection intensity will be only 0.5 standard deviations above average.

The parameter of heritability is used to calculate selection response. The square root of heritability is called accuracy (h). The formula for selection response after using a certain superior male in a goat herd is one-half of the product of accuracy, times selection intensity, times the additive genetic variance for the trait. The reason for "one-half" is, of course, that only half of the sire's genetic superiority is passed on to his progeny. Selection response is the genetic change due to selection in one generation. Many times, interest lies in the genetic change per year. To obtain this estimate, one must divide by the generation interval (t), which is the average age of the parents when their progeny are born. For example, if the heritability of yearling weight is 0.49, then the accuracy is the square root or 0.7. The generation interval of goats is two years. According to the above formula, the answer in the case of 10% selection intensity (equal to 1.75 standard deviations) would be (1/2(0.7)*(1.75))/2=0.31 standard deviations selection response per year for strictly male selection only. If however, 70% all females selected is the selection intensity program, then the selection progress becomes, ac-

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cording to the same formula, (1/2(0.7)* (0.5))/2=0.09 standard deviations selection response per year above herd average. If both programs are combined, the answers are combined and the selection response for yearling weight becomes 0.4 standard deviations progress per year in average.

Selection for more than one trait based on independent culling levels is accomplished by ranking candidates for both traits and requiring the selected animals to meet a minimum standard in both traits. This process is repeated each year with only minimum standards adjusted for progress made by selection.

Compromises have to be made for goats which are superior for the one trait but just below borderline for the other trait. This has led to the procedure of Selection Index which allows ranking animals simultaneously for two or more traits in one single index.

A selection index is calculated from the sum of trait means each multiplied by appropriate factors which weigh their relative importance genetically and economically. An index provides the opportunity for multiple trait selection. For example, a goat breeder considers trait 1 two times as important as trait 2. Hence, trait 1 would have a weighting factor double that of trait 2. Selection index, under certain assumptions, can maximize selection response for both traits.

Breeding Systems
Random mating is a system where an individual goat has an equal opportunity to be mated with any other individual of the opposite sex. The mating of two particular goats occurs essentially by chance in that no breeder decision was made to join them as mates.

Assortative mating is based on phenotypic performance or characteristics. Mating individuals of like performance is positive assortative mating, e.g., large goats to large mates and small to small. Mating individuals of unlike performance is negative assortative mating, e.g., large goats to small mates. Positive assortative mating tends to cause more variation in the total population of progeny than would occur from random mating, and negative assortative mating tends to reduce the variation. Assortative mating is practiced for type (conformation) traits. For example, "corrective" mating for progeny of a doe with certain physical weaknesses to a buck with strengths in those attributes would be negative assortative mating. Perpetuating strengths of a given line by selecting a buck also strong in those characteristics would be positive assortative mating. Assortative mating deviates from random mating in that decisions by the breeder based on phenotypes exclude or reduce the possibility of some matings.

The concept of relationship is important in deciding on certain breeding systems. The basic principle involved in determining relationship is that a parent passes one half of its gene complement to its progeny. Hence, in a non-inbred population, a parent is related to its progeny by 0.5, meaning 50% their genes are in common or they have a relationship of 50. Other types of relationships in non-inbred populations are calculated as products of this 0.5 or (1/2). For example, the relationship between paternal half-sibs (progeny of the same sire mated to different dams) is 25 as can be seen in the following diagram:

dam 1 > progeny 1 < sire > progeny 2 < dam 2

Each progeny receives a sample half of the sire's genes. The portion of genes that progeny 1 received from its sire, which are replicates of the same genes received by progeny 2, is (1/2) times (1/2) or 0.25

The relationship of a goat (C) to its grandparent (A) is also 25 because:

great-grandparent (E)
\/
grandparent (A)
\/
parent (B)
\/
progeny (C)

Parent goat B received one half of its genes from grandparent A and in turn passes one half of its genes to progeny C. The relationship is (1/2) times (1/2) or 0.25.

The relationship between C and its great-grandparents (E) would be one half of 0.25 or .125.

A quick method of calculating relationships between two individuals in a non-inbred population is to set each "arrow" between related individuals equal to 1/2 and multiply. This is equivalent to raising 1/2 to the nth power, $(1/2)^n$, where n represents the number of arrows or generation steps. The relationship of goat D to goat E having a common grandparent (A) would be:

grandparent A
\/ \/
parent B parent C
\/ \/
progeny D progeny E

$(1/2)^4$ or 1/16 or .0625 since there are 4 arrows or generation steps connecting D with E.

The degree of inbreeding of a particular individual equals one half the relationship of its parents. This value is called the in-

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breeding coefficient (F). The progeny resulting from mating a sire to his daughters has an F of 0.25, while mating two paternal half-sibs results in a progeny inbred .125.

The consequence of inbreeding is increased homozygosity or likeness of genes. If an individual goat has two unlike genes at a particular trait locus it is called heterozygous. However, an inbred animal has more loci in homozygous states than the average non-inbred animal. For a particular trait, there is a higher number of homozygous individuals in an inbred population than in a non-inbred one. Over time with inbreeding, certain genes which were present in the initial population may get lost in subsequent generations. Within an inbred line, the tendency towards fixation of few genes reduces the amount of genetic variation. In the absence of selection, genes are lost or fixed at random. The variation between inbred lines increases, however. Inbreeding can be used to create diverse lines.

An advantage of an inbred goat as parent is the increased uniformity in its progeny. Uniformity does not imply superiority, which is a function of genetic merit. An inbred animal may or may not be superior. Since inbreeding increases homozygosity in a population, it follows that this includes undesirable recessive genes. Hence, with inbreeding, the risk exists that one would generate a higher incidence of homozygotes for lethal, sublethal, and undesirable genotypes than occurs in random mating populations.

A second negative aspect of inbreeding is inbreeding depression, which is reduced performance related to increased homozygosity. The traits most influenced by inbreeding depression are in general those which have low heritabilities. Unfortunately, this includes such traits as viability and reproductive performance. A realistic threat associated with intensive inbreeding is producing a population of goats unable to survive or reproduce well enough to maintain the population.

Inbreeding occurs from breeding programs designed to mate relatives and in small herds where introduction of outside breeding stock is rare. The rate of change per generation in the average level of inbreeding is not large enough in most herds to be of concern. For example, if one uses 5 bucks selected from within a herd of 50 does, the level of inbreeding increases by 0.0275 per generation. However, in small herds where, for example, two bucks may be used on 20 does, the increase is 0.069 per generation. A progeny from two unrelated, inbred parents has an inbreeding coefficient F of zero. If a breeder feels his herd is getting too inbred, he can relieve the problem in the subsequent generation by using unrelated breeding stock. A breeder can also bring an unrelated, even though highly inbred sire into his herd without suffering the consequences of inbreeding depression in the progeny of that buck, because the progeny of two unrelated, although inbred, parents has an inbreeding coefficient of zero.

Line breeding maintains a high degree of relationship of individuals to a superior ancestor but has less severe consequences than inbreeding.

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          great grandparent A
              \/          \/
     grandparent B    grandparent C
         \/               \/
         parent D    parent E
                  \/        \/
            progeny Z
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Assume goat A was a buck used on several does in a herd generating daughters B and C. These daughters are mated to unrelated bucks and produce a son D and daughter E. The goats D and E are related to A by .25, but to each other by .0625

Assuming it was recognized that A was a truly superior buck and if his descendents were mated each generation to unrelated animals, the relationship of A to that progeny would continue to decrease by one half each generation. Progeny Z is related to great grandparent A not by .125 but by .25, because there are both parents D and E related to Z. Since D and E are related by .0625, progeny Z has an inbreeding coefficient of 3.15 The recapture of some of A's gene combinations is not certain but possible. The probability can be increased through line breeding or increased inbreeding with its other consequences.

The opposite mating system is designed to increase heterozygosity. Crossing of lines within a breed or the crossing of breeds are examples of such strategies. The fundamental assumption is that the genes at the various loci differ in the two parent lines or breeds. For many traits, the crossing of lines or crossbreeding results in progeny whose performance exceeds that which was expected from their parents' performance. This deviation is called heterosis or hybrid vigor and can be calculated as the difference from the expected.

Progeny exceeding their expected performance for a trait are not necessarily superior to both of the parental lines for that trait. Furthermore, crossbreeding influences all traits so that if complementary breeds are used, the total merit of the crossbreds may exceed each parental breed.

Heterosis is associated with dominant gene action. Assume that trait (A) has three possible genotypes with the following relative phenotypic values.

genotype:	AA	Aa	aa
value:	100	100	0

Gene (A) is dominant to its recessive allele (a) and the genotypes (AA) and (Aa) have the same phenotypic values. At a second trait locus (B) assume the values for the three genotypes are:

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genotype:	BB	Bb	bb
value:	100	50	0

There is no dominance at this locus since (Bb) is the average of the values of the two homozygous states. At a third trait locus (C) it is assumed that the following values exist:

genotype:	CC	Cc	cc
value:	100	60	0

there is incomplete dominance since Cc has a value exceeding 50 but less than 100.

Given these three loci and their relative values, one can now demonstrate heterosis from crossing two breeds of goats that have the following of the above genotypes:

Breed 1	Breed 2
AA	aa
bb	BB
cc	CC

The relative phenotypic value of each breed is the sum of the values of their genotypes at each of the loci. Breed 1 would have a value of 100 and breed 2 a value of 200; with an average for both parents of 150. Any crossbred progeny will be heterozygous at all three loci. Hence, their value will be the sum of their heterozygote values: 210. Heterosis for this particular crossing is 40 (210 - 150/150 =0.4). If all three loci had no dominance, then the heterozygote values at each locus would all be 50, and the value sum for the crossbred progeny would be: 150. Hence, with no dominance, the percentage heterosis is zero.

Heterosis is essentially the opposite of inbreeding depression and is also related to heritability. Those traits with low heritability usually show the greatest percentage of heterosis. These include viability and reproductive performance, both important characteristics in a total production system.

"AI? I and my friends are not in favor..."

All About Artificial Insemination (AI)

By G. F. W. Haenlein, University of Delaware, Newark, and M. C. Smith, Cornell University, Ithaca, NY

From the USDA Extension Goat Handbook

Is AI For You?

If you have a few backyard does that you enjoy as a hobby, with little concern for genetic improvements of their offspring, then artificial insemination (AI) is probably not for you, assuming a suitable buck can be located for servicing the does. The expense of purchasing the necessary equipment and learning to do AI are likely not worthwhile. However, if there is an experienced inseminator in the area who is willing to work with your goats, then this may prove to be a viable alternative and certainly is much simpler than hauling your does in heat to the buck's home.

AI has some key advantages over natural breeding.

1. It eliminates the necessity of keeping one or several bucks on the farm (depending on herd size). Costs of feeding, housing, separate fencing and labor are eliminated. However, heat detection may be more difficult in the absence of a buck.
2. AI can increase the rate of genetic improvement in a herd, as long as superior bucks are consistently selected. In natural service, the prospective breeder has only the buck's pedigree to rely on, whereas AI bucks should be progeny tested for their transmitting ability of milk and fat percentage, weight gain, type conformation, etc.
3. AI allows breeding of different portions of the herd to different bucks. Young does may be bred to not yet proven but high potential bucks, while the majority of the herd can be bred to proven high quality bucks.
4. AI permits breeding of many does on one day when synchronization is practiced. No long drives to top bucks are involved.
5. The danger of transmission of diseases or parasites is greatly reduced. (The transmission of diseases through frozen semen needs further study.)
6. The time of breeding can be more carefully regulated, and the owner knows exactly when the doe was bred, as opposed to pasture servicing by a buck that is allowed to run with the herd.
7. AI induces good recordkeeping of dates of heat, breeding, pedigrees, etc. This will aid in herd improvements and enable the owner to make better culling decisions.

Once the decision to use AI has been made, the next step is to determine whether to do the inseminating yourself or pay someone else to do it. If there are only a few does in your herd, and an experienced inseminator of goats is available, then it may be more practical to pay to have the service done. However, if the number of does in the herd is rather large, or an experienced inseminator is nowhere to be found, then its probably time to learn how to practice AI techniques yourself. AI technicians of the cattle industry may not necessarily be of much help when it comes to inseminating goats, for the modern method of inseminating cattle (rectal palpation) differs from that of breeding goats (speculum method) considerably. The speculum was used on cattle early in AI history, and some cattle inseminators may be capable of teaching goat insemination.

The cost of getting started in AI, not including semen purchases, will generally run around $500, of which $400 to $450 is tied up in the liquid nitrogen tank, which is necessary for storing semen any length of time. Temperatures must be kept at -320^{0}F (-196^{0}C) for sperm survival to be maximized at breeding time. It may be possible to share the cost of the tank with neighboring goat owners or dairy farmers, thus alleviating some initial costs of an AI program.

If AI is to be used with any hope of achieving a good level of success, the following information must be known and well understood by the prospective inseminator.

1. Basic knowledge of the doe's reproductive organs and their functions;
2. Understanding of storage and handling of semen;
3. Ability to use, in a proper and sanitary manner, the equipment required for inseminating goats;
4. Ability to accurately detect heat at an early stage;
5. Necessity of keeping accurate, up to date records of heat cycles, breeding, kidding, reproductive problems, treatments, and any other pertinent information that may reflect on the goat's reproductive patterns.

Reproductive Organs and Functions

The two ovaries are the sites of egg formation. They produce estrogens and progesterone, and as such are determining factors of heat cycle, ovulation and pregnancy. Basically the estrus (heat) cycle in goats operates as follows:

Proestrus is the time of follicle growth. As an egg (ovum) begins to mature in an ovary, it becomes surrounded by a fluid filled sac on the outside of the ovary, much like a blister forms on the skin. This growth is accompanied by increasing levels of estrogen in the blood.

Estrus - As estrogen levels peak, the doe will come into heat. This can be observed by changes in behavior (increased bleating and restlessness), willingness to be bred, and the swelling of the external genital area. The period of "standing heat" (acceptance of the buck) will generally last for 24 to 36 hours.

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Ovulation, or the release of the egg, is accomplished by the rupturing of the follicle, expelling the egg from the ovary, and receiving it into the oviduct via the fimbria funnel. This occurs very near, or soon after, the end of standing heat (6 hours before to 12 hours after). Egg life is 12 to 24 hours, while the sperm lasts 24 to 48 hours.

Metaestrus - in this stage, the ruptured follicle is undergoing cellular differentiation to form a functionally important tissue mass, the corpus luteum (yellow body). This structure is responsible for the secretion of progesterone, a hormone which prevents the development of another follicle and prepares the uterus to receive a fertilized egg.

Diestrus - is the longest period of the estrous cycle in does. During this period of corpus luteum influence, two events may happen:

1. If fertilization of the egg occurred, the corpus luteum will persist for the entire gestation period, preventing follicular development and keeping estrogen levels low.

2. If no fertilization took place, the progesterone secretions of the corpus luteum gradually lessen, allowing a new cycle of follicular development to begin, with a corresponding increase in estrogen levels. The length of time required for one estrous cycle without fertilization, ranges from 17 to 24 days in goats, with the majority taking 21 days. Shorter cycles are not uncommon (5-10 days).

The egg, after being expelled from the ovary, passes into the oviduct via the infundibulum, and toward the cornua (horns) of the uterus. This movement is produced by wave-like motions of the ciliated (hair-like projections) cells of the oviduct. Sperm and eggs meet in the oviduct and fertilization occurs in the middle to upper one third of the duct.

The egg continues into the horn of the uterus, where, if it has been fertilized and undergone several cellular divisions, it will become attached to the uterine wall. If no fertilization has occurred, the egg will degenerate and the cycle goes on.

The cervix of the uterus plays a key role in artificial insemination, as it is the external entrance to the uterus which must be located and penetrated with the inseminating instrument. The cervix is normally tightly closed, except during periods of heat or kidding. Semen is deposited on the vaginal side of the cervix in natural services, but AI requires the deposition of semen in the uterine side of the cervix. This is because of the greatly reduced volume of semen that is used in AI. If the 0.5 to 1 cc of semen in AI were deposited on the vaginal side of the cervix, there is a good chance that none of the sperm would reach the egg.

The vagina serves as the connecting tube between the uterus and the outside opening, the vulva. It is part of the birth canal, and also contains the urethral opening, from which urine will pass during emptying of the bladder.

Purchase and Preparation of Semen

In most cases, the inseminator will acquire the semen needed by direct purchase from a commercial operation, in which case it will be shipped to the inseminator. It is of the greatest importance that the semen be transferred to permanent storage (the liquid nitrogen tank) without exposing it to anything approaching air temperature. Generally, this means transferring the container element which houses the semen directly to the liquid nitrogen tank. Here it can be safely stored for long periods of time, since biological activity practically stops at liquid nitrogen temperatures (-320^{0}F). Semen is generally to be used within 6 months, but conceptions have resulted from semen stored for several years, although sperm survival is decreased, resulting in lower conception rates.

Semen Collection

Bucks are handled basically the same way as bulls for semen collection. Three basic methods may be employed, but all three require an artificial vagina, a double walled device with an opening at one end and collection tube at the other. The inner lining holding warm water should be coated with a light application of water soluble lubricating jelly. The three methods are:

1. A buck may be allowed to mount a doe, with the semen collector manually diverting the buck's penis into the artificial vagina (ram or dog size). Don't touch the penis directly, instead direct the penis into the artificial vagina by grasping the buck's sheath. After ejaculation (usually 0.5 to 1.0 cc) has occurred, remove the artificial vagina and tip it so that the semen will all run into the collection tube. This method may require practice and adjustment by both the buck and the collector before good samples are collected.

2. A buck is trained to mount a dummy instead of a live doe. The same procedures are followed for sample collection. Mounting may be facilitated by applying vaginal mucus scrapings of a doe that is in heat to the dummy, at least during the training process.

3. Use of electro-ejaculation. The buck is not required to mount an object, although an artificial vagina should still be used for semen collection. An electrode unit, which has a number of contact rings, is inserted into the buck's rectum. Slight electric stimulation brings on ejaculation. This technique generally results in good samples in quantity and quality. However, the sperm concentration of the sample will be lower. This method does not require extensive training, and will allow collections from bucks that may refuse or are unable to mount and serve an artificial vagina.

Semen, once collected, may be used in one of three different

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ways:

1. As liquid semen, directly or on the same day one ejaculate can serve 3 to 5 does. If kept at body temperature, the semen may be good for three hours.

2. Semen may be stored 24 to 48 hours by placing the collection tube in a container of water and putting this unit in a refrigerator. No diluter is needed, although plain egg yolk can serve as simple extender to double the number of does that can be served.

3. Semen that is to be stored for longer periods of time must be mixed with a diluter and very carefully frozen. A commercially prepared diluter extender, such as Ortho Semen Diluter is desirable, although plain milk can be used successfully also. Following are steps in semen extending:

a) with a commercial preparation, use a diluter to semen ratio of 19:1, adding the semen to the diluter, and rolling the bottle gently to achieve a thorough mixing. The semen and diluter should be at the same temperature. This mixture can be stored in the refrigerator and used for a week, or slowly cooled and stepwise frozen for storage in a liquid nitrogen tank for later insemination.

b) for a homemade milk diluter, it is best to use fresh 3.5 pasteurized, homogenized whole milk. It must be heated and held at 21^{0}F for 10 minutes in a glass boiler, keep the lid in place so that no moisture is lost. Next, the milk is cooled in a water bath with the lid on. When the milk is in equilibrium temperature with the water bath, the water condensation on the inside of the lid is shaken back into the milk. To every 400 cc of milk, add 100,000 units of potassium G crystalline penicillin and 500 mg crystallin di-hydrostreptomycin sulfate, mixing well. Warm this diluter to about body temperature before adding the fresh semen at 19:1 ratio. Place the diluted semen in a water bath at body temperature of 101^{0}F and allow to cool slowly. Semen may be frozen, if the extender contains an antifreeze compound, slowly, stepwise for storage on dry ice or in liquid nitrogen.

A microscope, capable of 900x magnification is an essential tool when doing your own semen collection in order to determine semen quantity and quality. First, place a semen sample on a clean slide and cover with a coverslip or another slide. Set the magnification to 400x and observe the appearance of dark patches or spots through the scope; four dark areas or more per microscope field represent high concentrations of sperm, a really good sample. Three dark areas is somewhat chancy for use at a diluted service, but is good enough for natural service. Two dark areas should be used only for natural services and one dark area means that the concentration of sperm is too low for even natural service.

Switching to 900x, the sperm cells can be individually observed for normal structures. Diluting in warm saline is helpful. Coiled tails, broken tails, absence of tails and abnormal shapes all constitute deficient sperm cells. Sixty to 70% motility before freezing should be observed in a good sample, with a minimum of 30% motility after freezing and thawing. Any insemination program, no matter how carefully carried out, will yield poor results if the concentration and quality of the collected sperm is not of high standards. Sophisticated techniques of washing the sperm free of seminal plasma before extending and freezing will improve post-thaw viability.

The concentration of a buck semen ejaculate can be determined accurately by using a red blood cell diluting pipette and standard hemocytometer techniques. Typical results during the breeding season are 3 to 5 billion sperm per cc. Optical density can also be used to estimate sperm concentration if the photometer has been calibrated for buck semen. A simpler technique involves the determination of a spermatocrit using microhematocrit pipettes. The aliquot of semen is centrifuged for 10 minutes; for each percentage point of packed sperm, approximately 200 million sperm cells per cc are present. Correction is made for the percent motile sperm, after which the ejaculate can be diluted appropriately to supply a minimum of 125 million motile sperm in each breeding dose. It is often difficult to introduce more than 0.2 ml of semen into the cervix, so dilution to a final concentration of 600 million to 1.2 billion live sperm per cc has been recommended. When no laboratory support is available, fresh semen for immediate use may be diluted up to 5 times in extender if it is yellowish and 10 times if the ejaculate is white. A straw holding 0.5 cc of this diluted semen will provide adequate sperm if excessive reflux does not occur.

Storage and Removal of Semen from the Liquid Nitrogen Tank. A liquid nitrogen tank is basically a very large thermos-bottle in which liquid nitrogen is placed to keep the inner temperature near -320^{0}F (-196^{0}C). The spacing between the inner and outer walls is insulated and under vacuum. The temperature in the tank is maintained uniformly at -320^{0}F up to the bottom of the tank neck until the liquid nitrogen level gets down to around 5". To measure liquid nitrogen, use a piece of black metal rod that is long enough to hold and touch the bottom of the tank. Dip the rod to the tank bottom and remove after 30 seconds. By waving it in the air, a white frost line will appear on the rod. This line indicates the liquid nitrogen depth of the tank. Levels nearing 5" require a refill. The only real differences between tanks is their storage capacity (number of ampules or straws that they will hold) and their length of holding time (liquid nitrogen evaporation rate). The neck diameter varies somewhat also, with wider openings being easier to work with, but an increased evaporation rate usually results.

When working with semen in the liquid nitrogen tank, it is important to keep the racks below the frost line in the neck of the tank. Removal of semen from the tank for periods as brief

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as 10 seconds, such as for identification, before replacing it to the tank will often result in lowered fertility levels. If the right rack can't be located in 5 seconds, lower the canister back to the bottom of the tank for at least 30 seconds before trying again. Also, when handling semen, try to stay out of any direct sunlight, as ultraviolet light has a spermicidal effect.

The semen comes in two basic types of packaging: ampules (1 ml) and straws (0.5 or 0.25 ml). The ampule is the most common type of packaging for buck sperm. Both ampules and straws are stored in racks (canes), which are aluminum pieces that hold a vertical row of ampules.

A few key reminders concerning semen storage:

1. Always keep the liquid nitrogen level above 5".
2. Never lift a canister above the frost line of the tank.
3. When the semen is removed with a forceps from the tank it should be placed immediately in the thaw box.
4. Never expose semen to direct ultraviolet light.
5. Never refreeze semen that has been thawed as it will be destroyed.
6. Check for proper identification on ampule or straw.
7. A defective ampule may blow up after it is removed from the tank. This is due to a small leak that allows nitrogen to enter the ampule. When removed from the tank, the gas expands too rapidly to vent back out the hole and it explodes the glass. A hissing sound is usually audible when it is removed. Keep your hand between the ampule and your face when putting it into thaw box.
8. Always wear gloves and goggles for your own protection when working inside a liquid nitrogen tank.

Thawing Procedures

Methods for semen thawing vary among manufacturers, and it is best to follow their recommendation. The thawing procedure for 1cc ampules, the most common for goat semen, is generally the ice water bath:

1. Ice water (38-42F) is placed in a styrofoam box long enough beforehand to allow temperature to equilibrate.
2. Remove the ampule from tank and place immediately into thaw box. Ampule may be placed in a small plastic cup with holes in the bottom. This prevents ice from coming into direct contact with ampule.
3. Ampule should thaw in 3 to 5 minutes. Check for slushiness and allow more time if needed.
4. Ampule may sit in ice water for as long as 30 minutes with no damage. Once removed, the semen must be used right away.
5. The layer of ice on the ampule must be peeled off before opening to avoid possible contamination.

The ice water thaw method is especially good during winter breeding of does because of low risk of cold shock to thawed and exposed semen. Thawing of semen can be done from -32^{0}F rapidly, but any subsequent exposure to lower temperatures after thawing will kill many or all of the sperm.

The warm water method of thawing is more exact than the ice water method, but probably will not work in cold weather, although it may give somewhat better results the rest of the year. The procedure is basically the same as for the ice water thaw except that:

1. The water must be maintained at 92 to 98F. This requires a source of warm water and an accurate thermometer.
2. Thawing will be complete in about 1 minute with no ice layer formation of the ampule.
3. Ampules thawed with the warm water method should be used within 5 minutes.

Straws (0.5 or 0.25 ml) can be thawed by either of the previous two methods. A given amount of semen in a straw will take about one half as long to thaw as an equal amount in an ampule. Many inseminators simply thaw straws by placing them into their shirt or pants pocket.

Inseminating Procedures

All the care in handling, storage and preparation of semen will be useless if the inseminating process is not done carefully and cleanly. Hygienic practices at this point cannot be overemphasized. All reusable items such as inseminating guns (for straws), scissors for cutting straws, scribe for cutting ampules, etc. must be wiped clean with 70 0sopropyl alcohol and allowed to dry before reuse. Disposable items should be kept in their sealed packages until they are to be used. The speculum should be sterilized after each use (this is one reason why the cattle industry discontinued the speculum method; the inseminator would have to carry a few dozen specula on his daily rounds, sterilizing them each night). This is best accomplished by boiling for 10 minutes, allowing to air dry. Then place inside a sterile container or wrapping, such as a new plastic AI glove. Disposable plastic type specula for goats can be obtained from mail order companies, eliminating the need for constant resterilization.

Materials needed for artificial insemination:

1. Speculum, Pyrex 22 x 175 mm for doelings; 25 x 200 mm for adult does; or stainless steel human vaginal speculum; or plastic disposables; with a small clip-on flashlight.
2. Sterile lubricating jelly (K-Y)
3. Thaw box
4. Inseminating pipette with bulb or syringe (ampules only) or Inseminating gun (straws only)
5. Paper towels
6. Facility for securing doe (stanchion, fence, rope hoist)
7. Recording journal for breeding dates, buck's name, etc.

Preparing Ampules:

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1. Partially remove an inseminating pipette from its plastic bag.
2. Place bulb or syringe on exposed end.
3. Thaw ampule according to the described methods.
4. Dry ampule after thawing, hold in paper towel and scribe (with proper tool) one side of ampule collar. Some ampule types do not need to be scribed, but can be snapped open.
5. Pull syringe back 1/2 cc on plunger or squeeze bulb closed before placing pipette into ampule.
6. Tip ampule to slight angle and maintain constant suction on pipette while it is slowly inserted into the ampule. Try to get all the semen into the pipette, keeping the semen column down near the end of the pipette.
7. When filled, the pipette should have a semen column with no air spaces, with the bottom of the column being 1 to 2" from the pipette tip. Do not draw semen into the syringe or bulb.
8. Keep the ampule for information to complete breeding records.
9. Keep the pipette away from sunlight or cover with paper towels.
10. The semen is now ready to be placed into the doe in estrus.

Preparing Straws:

1. An inseminating gun, designed for your type of straw is needed, obtainable through farm supply houses or the local cattle AI technician. Have cover sheath available, sealed until needed.
2. Place straw in thaw box.
3. Remove when thawed, wipe dry. Check buck information.
4. Pull plunger on gun back 4 to 6" and insert straw into gun, cotton plug end first (towards plunger).
5. Hold gun in upright position, allowing air bubble to rise to the sealed end.
6. Cut sealed end of straw with scissors. Take care to cut straw squarely for proper seating.
7. Install the sheath over the gun, fastening it down with the provided O-ring. Install it so that the wider side of the ring faces the straw, with the narrower side facing the syringe end.

Insemination: Assuming that the doe has been observed in heat, has been suitably restrained (i.e. in stanchion) and the steps for preparing the ampule or straw have been followed. The next steps are:

1. Position doe on milk stand. The inseminator places his left foot on the stand and drapes the hindquarters of the goat across his horizontally positioned thigh. The goat is allowed to stand as long as she does not struggle or collapse. The vulva is cleaned.
2. Hold pipette or inseminating gun, wrapped in a paper towel, in your mouth; or let someone else hold it if extra hands are available.
3. Turn head light on and insert lubricated speculum in a slow and gentle manner. Begin entrance at a somewhat upward angle for the first several inches. This is to prevent the speculum from scraping across the vaginal floor, possibly doing damage to the urethral opening.
4. Complete insertion of speculum and locate cervix. Center the end of the speculum over the os uteri (entrance to cervical canal).
5. Cervix should be of a red-purple coloration with a viscous whitish mucus present if doe is truly in heat.
6. Insert pipette or inseminating gun into speculum to the cervix. Gently manipulate the instrument through the cervical canal (cervix is 1 to 2" long) to the 4th or 5th annular ring.
7. Deposit semen near the uterine end of the cervix or just inside the uterus. Do not enter too far into the uterus as the semen will then tend to be dumped into one horn or the other. If the semen is pushed into the wrong horn (i.e. egg produced in left ovary, semen dumped into right horn) then fertilization may not occur.
8. Deposit semen slowly, taking at least five seconds.
9. Slowly withdraw instrument without release of syringe or depressed bulb, then carefully remove the speculum.
10. Record all pertinent breeding information.
11. Carefully discard all disposable materials. Arrange to sanitize reusable items and sterilize the speculum (if it is a non-disposable type).

Frequently, the pipette cannot be passed all the way through the cervix even though the doe is in heat. If it has penetrated deeply into the cervix (3 to 4 cm, as determined by laying another pipette alongside the first and observing the distance by which the outer ends are offset), cervical insemination will provide a conception rate almost equal to that of intrauterine semen deposition. The conception rate expected from intravaginal insemination, however, is less than 30%. If semen is very valuable, it may be advisable to pass a trial pipette to determine patency of the cervix before thawing the semen unit.

In France, a doe is usually restrained by a second person who straddles the doe's neck and elevates the hindquarters to a vertical position while holding the hind limbs tightly flexed. The inseminator is free to stand in a comfortable position. He holds the speculum and the goat's tail in one hand and the pipette or straw gun in the other hand. If excess mucus is a problem, the assistant lowers the goat's hindquarters almost to the ground; if the mucus does not run out of the speculum, the latter is removed and shaken to clear it. The goat is then lifted to its former position. If many goats are to be bred, the assistant may tire using this technique. If the doe is not held in a vertical position, it is often impossible to adequately visualize and penetrate the cervix. Various slings have been devised to suspend the goat in the appropriate position.

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Calendar of Events

September 20 - 21, 2003
Finger Lakes Fiber Arts Festival, Hemlock Fairgrounds, Hemlock, NY, Info: Robin Nistock, 10137 Mattoon Rd., Plattsburgh, NY 14873, 607-522-4374, sheepmom@empacc.net

September 20 - 22, 2003
California Wool and Fiber Festival
Mendocino County Fairgrounds, Mendocino, CA
71st annual California National Wool Show, vendors
Info: Loretta Houck, 707-894-5966, internet: www.fiberfestival.com

September 27 - 28, 2003
Oregon Flock and Fiber Festival - 7th annual Clackamas County Fairgrounds, Canby, Oregon. Cashmere goat show (9/27 - 9 AM), wool show and sales, fiber, skein and fiber art competitions, vendors, workshops, sheep and goat shows. It's an event! Don't miss it!
Information: http://www.flockandfiberfestival.com
Information for entering cashmere goat show - see page 26, this issue.

September 30, 2003
ECA cashmere fleece competition, Virginia State Fair, Richmond, VA. Info: Lisa Vailes, 540-885-1261, lvailes@inbio.com. Detailed instructions page 5, this issue. Also, workshop on goat health (especially parasite control) and nutrition by Dr. Joe Tritschler, Extension Animal Scientist, VSU.

October 1, 2003
ECA cashmere goat show, Virginia State Fair, Richmond, Virginia. Show Superintendent: Lisa Vailes, contact information above under September 30th events.

October 4 - 5, 2003
Vermont Sheep & Wool Festival, Essex Junction, Vermont. Sheep & other fiber animals, handspinning and fiber competitions, demonstrations, vendors, exhibits, workshops. Info: Kat Smith, 136 Jack Perry Rd, Wallingford, VT 05773.

October 18 - 19, 2003
NOT 9/18 as printed in the 2003 CM calendar!
New York Sheep and Wool Festival, Rhinebeck, New York, ECA cashmere goat show (10/19), Joe David Ross, Judge. Also workshops are in the works—potentially spinning cashmere! Information: Wes Ackley, ackley@megalink.net or 207-336-2948.

Association Contacts

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Continued on next page

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Phone/fax: 540-436-3546
cashmere@shentel.net

WASHINGTON

BREEZY MEADOW CASHMERE FARM
Douglas and Roberta Maier
810 Van Wyck Rd.
Bellingham, WA 98226
360-733-6742
fibergoat@earthlink.net

BROOKFIELD FARM
Ian Balsillie/Karen Bean
PO Box 443
Maple Falls, WA 98266
360-599-1469 or
360-715-1604
brookfarm@earthlink.net

LIBERTY FARM (NLF)
Cliff and Mickey Nielsen
5252 Hwy 12
Yakima, WA 98908
509-965-3708
mnielsen7@aol.com

SHEA LORE RANCH
Jeremiah and Nancy Shea
4652 S. Palouse River Rd.
Colfax, WA 99111-8768
Phone: 509-397-2804

STILL WATERS CASHMERE
Moon and Diana Mullins
PO Box 1265
Twisp, WA 98856
509-997-2204
509-429-0778
dmullins@methow.com

Internet listing of these breeders and a link to their email addresses and homepages, can be found on the internet at:

http://www.cashmirror.com/breeders.htm

All About AI
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Classified Advertising

Attentive group at July NWCA Field Day watch a hoof trimming demonstration.

Display Advertising Rates:

Ad Size	Price (Issue / 4 mos. / 1 yr.)
Business Card	$25 / 100 / 150
1/4 page	$45 / 165 / 410
1/3 page	$65 / 240 / 600
Half Page	$80 / 300 / 730
Full Page	$150 / 550 / 1,370
Other sizes, options	Ask us

Extensive layout or photo screening may be extra.
Payment must accompany ad order.
Free Breeders' Listing with any annual ad.
Classified ads 50 cents/word.

Notable Quotes

"If a man watches three football games in a row, he should be declared legally dead.'"

...Erma Bombeck

"No act of kindness, no matter how small, is ever wasted."

...Aesop

"Goats are smart—smarter than some people."

...Albert Roberts
Goat cheese maker, Omak, WA

"It is somewhat of a truism in animal breeding that you measure your animals against themselves. In other words, while there are breed standards and norms across the industry, your decisions whether to cull, keep or breed have to be based on a decision of how that animal and its characteristics rank against others in your herd, not some outside ideal."

...Tom Dooling, "Advanced Cashmere Breeding", 1996

The Deadlines:

Articles, photographs, advertising and other information submitted must be received by the 25th of the month prior to magazine issue date.

If you need assistance designing or laying out a display ad, or fine-tuning an article, earlier is appreciated.

CashMirror Subscription Information

To subscribe

Send: Name
Farm Name (if applicable)
Address with zip code

To: CashMirror Publications
2280 S. Church Rd.
Dallas, OR 97338

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Breeders Directory listing for full year $30.